2005-03

Analysis of career progression and job performance in internal labor markets the case of federal civil service employees

Spyropoulos, Dimitrios.

Monterey, California. Naval Postgraduate School

NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

ANALYSIS OF CAREER PROGRESSION AND JOB PERFORMANCE IN INTERNAL LABOR MARKETS: THE CASE OF FEDERAL CIVIL SERVICE EMPLOYEES

by

Dimitrios Spyropoulos

March 2005

Thesis Advisor: Stephen L. Mehay
Second Reader: Elda Pema

Approved for public release; distribution unlimited.

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE			*Form Approved OMB No. 0704-0188*
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.			
1. AGENCY USE ONLY *(Leave blank)*	**2. REPORT DATE** March 2005	**3. REPORT TYPE AND DATES COVERED** Master's Thesis	
4. TITLE AND SUBTITLE: Analysis of Career Progression and Job Performance in Internal Labor Markets: The case of Federal Civil Service Employees			**5. FUNDING NUMBERS**
6. AUTHOR (S) Dimitrios Spyropoulos			
7. PERFORMING ORGANIZATION NAME (S) AND ADDRESS (ES) Naval Postgraduate School Monterey, CA 93943-5000			**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited			**12b. DISTRIBUTION CODE**

13. ABSTRACT (maximum 200 words) The objective of this thesis is to investigate various factors that influence the job performance and promotion of DOD civilian workers. The data used in this study were drawn from the Department of Defense Civilian Personnel Data Files provided by the Defense Manpower Data Center (DMDC). The initial data was restricted to employees who were initially hired in 1995 and stayed in service until 2003 and were paid under the General Schedule (GS) pay system. Three general performance measures were used: compensation (salary), annual performance ratings and promotions. Multivariate models were specified and estimated for each of these performance measures. The results indicate that females receive lower annual and hourly compensation and are less likely to be promoted than men even though they receive better performance ratings. The results also indicate that minorities are paid less and are less likely to be promoted than majority workers while veterans are paid more, perform better, and are more likely to become supervisors. The models also reveal that performance rating is a weak measure of productivity and that more highly educated employees are paid more and more likely to be promoted more even if they are not always the best performers.

14. SUBJECT TERMS Performance, Promotion, Retention, Compensation, Selection Bias.			**15. NUMBER OF PAGES** 87
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UL

NSN 7540-01-280-5500 Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release; distribution is unlimited.

ANALYSIS OF CAREER PROGRESSIOJN AND JOB PERFORMANCE IN INTERNAL LABOR MARKETS: THE CASE OF FEDERAL CIVIL SERVICE EMPLOYEES

Dimitrios Spyropoulos
Lieutenant Commander, Hellenic Navy
B.A., Hellenic Naval Academy, 1988

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
March 2005

Author: Dimitrios Spyropoulos

Approved by: Stephen L. Mehay
Thesis Advisor

Elda Pema
Second Reader

Douglas A Brook
Dean, Graduate School of Business and Public Policy

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

The objective of this thesis is to investigate various factors that influence the job performance and promotion of DOD civilian workers. The data used in this study were drawn from the Department of Defense Civilian Personnel Data Files provided by the Defense Manpower Data Center (DMDC). The initial data was restricted to employees who were initially hired in 1995 and stayed in service until 2003 and were paid under the General Schedule (GS) pay system. Three general performance measures were used: compensation (salary), annual performance ratings and promotions. Multivariate models were specified and estimated for each of these performance measures. The results indicate that females receive lower annual and hourly compensation and are less likely to be promoted than men even though they receive better performance ratings. The results also indicate that minorities are paid less and are less likely to be promoted than majority workers while veterans are paid more, perform better, and are more likely to become supervisors. The models also reveal that performance rating is a weak measure of productivity and that more highly educated employees are paid more and more likely to be promoted more even if they are not always the best performers.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF GRAPHS

THIS PAGE INTENTIONALLY LEFT BLANK

ACKNOWLEDGMENTS

I would like to acknowledge and thank my beautiful wife, Dora, for her unwavering patience and understanding during my long hours in study and away in class. I also dedicate this thesis to my father, Spyros Spyropoulos, who passed away during my tenure at NPS. Spyros inspired me to always strive to do my best, and continually encouraged me with his wisdom and support.

THIS PAGE INTENTIONALLY LEFT BLANK

DISCLAIMER

This thesis was written by LCDR Dimitrios Spyropoulos while a student at The Naval Postgraduate School studying for a Master's Degree in Management. The views expressed in this article are those of the author and do not reflect the official policy or position of the Department of the Navy, Department of Defense, or the U.S. Government.

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

The purpose of this research is to examine the various factors that affect the job performance and career progression of DOD civilian workers. By understanding the career patterns and performance of DOD civilian employees, the present study will provide decision makers with additional tools to: 1) evaluate personnel productivity and performance issues; 2) improve the utilization of available resources; 3) increase DOD effectiveness in accomplishing tasks by improving workforce productivity; and 4) develop strategies for working with a diverse workforce.

The study will focus on differences in job performance and career progression among various demographic groups and among employees with and without advanced education. It will specify and estimate performance rating, promotion, and earnings models for the cohort of civilian DOD employees hired in 1995 and will investigate the relationship between human capital characteristics and selected career outcomes.

Human capital theory suggests that an individual's productivity increases with additional education. It is generally assumed that education changes an individual in such a way as to increase her/his capacity to perform job-related tasks [Wise, "Academic Achievement," 1975]. The thesis will examine the effect of possession of a postgraduate degree on promotion, earnings and performance ratings. Also, the thesis will address the correlation among compensation, grade level and job performance.

Promotion is another important personnel issue within organizations. It is a primary means for individuals to advance their careers. From the employee's point of view, promotion is important for meeting aspirations for increased responsibility, status and salary, while from the organization's point of view promotion is a way to meet human resource staffing requirements and to identify quality leadership. As a result, promotions are not random events; they are the by-products of staffing decisions made within the organization. Thus, it is very beneficial to federal decision makers to know the key factors that affect promotions in the DOD environment. The study will identify the effect of education at entry (hiring) point on promotions and promotion speed.

The study will also investigate retention (workers' quit decisions). A retention model will be useful to federal policy makers and personnel managers since public-sector worker turnover has only recently begun to receive rigorous attention (e.g., Borjas, 1982; and Burtless and Hausman, 1982). Federal compensation policy does have ramifications for employee retention with changes at the margin having a modest effect that varies across occupational groups. Labor market conditions, personal attitudes and job characteristics also influence individual decisions to leave (Black, Moffitt, Warner, 1990). Consequently, an organization must carefully monitor retention rates to ensure that the most productive workers are being retained. If not, the organization will eventually find itself in dire straits because it will not have the workforce needed to accomplish its mission.

A. BACKGROUND

1. Pay Systems and Promotion in the Federal Service.

The federal system in the U.S. Federal Government consists of 67 different pay plan categories. However, the "General Schedule" (GS) pay system (plan) and the "Wage system rate" are the two major pay systems. This thesis focuses on the GS system since the majority of DOD civilian white-collar employees belong to that category. White-collar employees represent the professional and technical portion of the DOD workforce.

The GS System is a pay system used to set wages for employees who work in positions classified in the administrative, clerical, professional and technical occupational categories. It mainly consists of 15 grades, or salary levels, and 10 steps within each grade. Employees progress through the steps, according to job performance and length of service. Waiting periods exist for all GS grades. Table 1 shows the waiting periods for progression to the next higher step.

Table 1. Step Increases and Waiting Periods for GS Federal Employees

From Step	To Step	Waiting Periods (Weeks)
1	2	52
2	3	52
3	4	52
4	5	104
5	6	104
6	7	104
7	8	156
8	9	156
9	10	156

Source: Celik (2002)

When an employee is promoted to a higher grade, that individual is allowed no more than a two-step increase (within grade) above the salary he/she received before the promotion. Advancement to a higher step represents a 3% salary increase, while promotion to a higher grade results in a 10% salary rise. When for some reason individuals have not reached the highest step for a specific position, they are advanced to the higher grade when the required time period is completed if their performance evaluation is rated at least "Full Successful" or equivalent and if no comparable increase was received during the period.

Compensation is also adjusted for local cost-of-living differences, called locality pay. Starting in 1994, locality pay was implemented for GS employees to address a gap between Federal and non-Federal salaries in localities throughout the U.S. [Office of Personnel Management], except those who were covered under special salary rates. Table 2 displays the General Schedule (base) pay for the year 1995, the year the employees in this sample first entered federal civil service.

Table 2. General Schedule (Base) Pay Table

GS	1	2	3	4	5	6	7	8	9	10
1	12141	12546	12949	13352	13757	13994	14391	14793	14811	15183
2	13650	13975	14428	14811	14974	15414	15854	16294	16734	17174
3	14895	15392	15889	16386	16883	17380	17877	18374	18871	19368
4	16721	17278	17835	18392	18949	19506	20063	20620	21177	21734
5	18707	19331	19955	20579	21203	21827	22451	23075	23699	24323
6	20852	21547	22242	22937	23632	24327	25022	25717	26412	27107
7	23171	23943	24715	25487	26259	27031	27803	28575	29347	30119
8	25662	26517	27372	28227	29082	29937	30792	31647	32502	33357
9	28345	29290	30235	31180	32125	33070	34015	34960	35905	36850
10	31215	32256	33297	34338	35379	36420	37461	38502	39543	40584
11	34295	35438	36581	37724	38867	40010	41153	42296	43439	44582
12	41104	42474	43844	45214	46584	47954	49324	50694	52064	53434
13	48878	50507	52136	53765	55394	57023	58652	60281	61910	63539
14	57760	59685	61610	63535	65460	67385	69310	71235	73160	75085
15	67941	70206	72471	74736	77001	79266	81531	83796	86061	88326

Source: http://www.opm.gov/oca/95tables/indexgs.asp//17-11-04

Eligibility for federal GS jobs is determined by education and/or work experience [Defense Logistic Information Service]. With a high school degree or three months of general experience, the individual is qualified for GS-2 grade level positions. To qualify for GS-5 or GS-7 grade levels, the employee needs a Bachelor's degree or three years of increasingly responsible work experience after high school. An undergraduate degree and a grade point average of 3.0 or higher (or membership in an academic honor society) meets eligibility requirements for the GS-7 grade level based on "Superior Academic Achievement." Applicants with Master's degrees are eligible for the GS-9 grade level, and those with Doctoral degrees may be considered for the GS-11 level. Grade levels for professional and administrative positions under the GS pay system initially increase in 2-grade intervals (that is, GS-5, 9, and 11) and then in 1-grade intervals (that is, GS-12, 13, 14, and 15).

2. Performance Management in the Federal Service.

There seems to be no completely satisfactory way to measure job performance (productivity). Some studies use salary and grade level as measures of success [Wise, 1975]. They assume that an individual's earnings reflect their marginal productivity and they link salary and performance directly. Other studies find that there is a substantial discrepancy in theories that imply a strong relation between wages and productivity [Medoff and Abraham, 1981].

In general, employers believe they can rate the productivity (performance) of their employees. Adjusting relative wage rates to reflect rated performance produces three benefits to the firm: 1) it serves as an incentive for greater effort; 2) it attracts more capable workers to the firm; and 3) it reduces the probability of losing top performers to other firms. James Medoff and Katharine Abraham (1980) have presented evidence showing a positive association between experience and relative earnings within grade levels in three U.S. manufacturing corporations. However, they found no association between experience and rated performance (productivity proxy). These findings are contrary to human capital theory, which states that the higher earnings of the more-experienced workers in a firm reflects their training which makes them more productive than their less experienced peers.

According to the DOD Directive 1400.25 on "Civilian Personnel Management Systems" (1996) the objective of performance management is to improve individual, team and organizational performance. To fulfill this aim, the performance management system establishes: 1) management accountability for equal employment opportunity; 2) affirmative employment practices; and 3) employment principles. To measure performance, DOD uses a "Performance Appraisal System" which establishes performance appraisal requirements and complies with Federal regulations. Federal employees are subject to periodic evaluations of their job performance and are classified according to a five-level rating scale shown in Table 3.

Table 3. Performance Appraisal Levels

Levels	Meaning of Codes
1	Unsatisfactory
2	Minimally Successful
3	Fully Successful
4	Exceeds Fully Successful
5	Outstanding
6	Not applicable

Source: DMCD

DOD employees with outstanding performance receive merit pay [Mehay and Pema, 2004].

3. Merit Promotion in the Federal Service

According to Condrey and Brudney (1992) federal agencies instituted merit pay in 1981 as part of the Civil Service Reform Act (CSRA). Due to numerous problems and criticisms of CSRA, Congress decided to replace that system with the Performance Management and Recognition System (PMRS) in 1984. The new system was not a retreat from the earlier one, but rather an attempt to reform and correct particular portions of the old system.

The positions covered by the merit promotion system do not regard political, religious, or labor organization affiliation or non-affiliation, marital status, race, color, sex, national origin, disability, or age. The merit promotion system is based solely on job-related criteria [Federal Merit Promotion Program]. To be eligible for promotion, employees generally must meet the position's qualification requirements, the time-in-grade requirements, the time-after-competitive-appointment restriction, and the requirements for fully successful performance. Employees are not promoted if their rating record is lower than "Fully Successful" at current grade or they have a below "Fully Successful" rating on a critical-to-performance element of the next higher grade of the career ladder.

B. ORGANIZATION OF THE THESIS

This thesis is organized into five chapters. Chapter II reviews relevant studies and the techniques used and summarize their findings. Chapter III describes the data set used in this thesis and defines the variables used in the econometric models. Chapter IV estimates the econometric models and describes their results. Chapter V summarizes the results of the analysis and makes recommendations for further research.

II. LITERATURE REVIEW

There are several prior studies that analyze performance, retention and promotion. However, only a few of them deal with career progression, job performance and retention in internal labor markets. This chapter discusses a few of the prior studies that analyze performance, retention and promotion. The prior studies serve as the basis for specifying and estimating the performance models developed in this thesis.

The study "Pay, Promotion and Retention of High-Quality Civil Service Workers" [Asch, 2001] examined the factors that affect performance (pay), promotion and retention of civil service workers. The questions addressed were whether promotion speed varies across occupational areas and whether higher-quality personnel are promoted faster, are paid more, and stay longer in the organization. To do so, Asch used data on fulltime GS civil service workers in the Department of Defense (DOD). The analysis covered more than 19,000 civil service workers and used a longitudinal database constructed from Defense Manpower Data Center (DMDC) personnel files that tracked the careers of individuals who entered or reentered the DOD civil service in a given year. In particular, the analysis focused on those civilians who entered or reentered DOD in fiscal year 1988, before the defense draw down, and those who entered or reentered in fiscal year 1992, during the draw down.

Three different models were created. The estimation methods used included ordinary least squares regression models (OLS) to analyze pay, and Cox regression models to analyze times to promotion and to separation (retention). The analysis relied on three measures of personnel quality: education, supervisor rating, and promotion speed. Three personnel outcomes were analyzed: pay, promotion speed, and length of stay. The personnel quality at time t was hypothesized to depend on education, motivation, ability and job factors, while an individual's supervisor rating was hypothesized to depend on personnel quality, monitoring frequency, technology, cost and subjective assessment. Promotion speed was hypothesized to depend on supervisor rating, job vacancy, willingness to move up and eligibility for promotion. Retention was specified as a function of promotion speed, pay and benefits inside and outside the civil service, and taste for federal service, while pay (performance) was defined as a function of supervisor rating, occupation, experience and seniority.

Asch mentioned three types of potential bias in the analysis: 1) selection bias that arises because tracked employees are ones who decided to stay; 2) a measurement error created by the exclusion of bonuses and special pay from earnings, the dependent variable; and 3) measurement error in the education variable. To test and correct for selection bias, Asch divided the cohort into two groups based on year of service, denoted as *t*: 1) those who separated at year *t*; and 2) those who stayed beyond that year. She then ran a separate model for each group and compared the results. Where the results were similar, she concluded that no selection bias was present. Where the results were not similar the estimates provided an upper and a lower bound at each year of service of how compensation increases through year *t*. Asch did not take any action to correct the possible measurement error created by the exclusion of bonuses and special pay from earnings. She assumed that, since the analysis controlled for factors such as occupational areas and geographic region, then those factors partially explained the incidences of bonuses and special pays. Furthermore, she also did not take any action to correct the measurement error in the education variable. She argued that, if the measurement error were greater for more educated people, then the effect on pay of people who have higher education would be biased downwards.

Taking into consideration the above, Asch found that, all else remaining constant, educated personnel and those who receive higher supervisor ratings--higher quality personnel--are paid more than those of lower quality--lower education and lower ratings. The analysis also found that: 1) higher-quality GS personnel are generally promoted faster; 2) the higher the supervisor rating, the faster the promotion speed; and 3) those with any college education are promoted faster than those without, with the exception that having advanced education beyond a BA degree did not always translate into faster promotion.

Asch's retention results were inconsistent. For the fiscal year 1988 cohort, the analysis indicated that those who were better matched to the civil service (better supervisor rating and faster promotion speed) had a stronger incentive to stay. For the fiscal year 1992 cohort, the evidence did not suggest that those who received better supervisor ratings stayed longer. In general, the analysis of retention in the DOD civil service provided some evidence that higher-quality personnel stayed longer, especially when quality was measured in terms of faster promotion and better performance rating. When the quality of personnel was measured in terms of education, retention results were different between the two cohorts.

The regression results for the two cohorts also suggest that careers vary significantly across occupational areas, despite the fact that all GS DOD employees are covered under the same pay table. Asch's analysis suggests that current DOD policies promote better GS workers and pay them more but may not be sufficient to retain them, especially employees with higher education.

In their study "Gender Differences in Job Performance and Career Progression: Evidence from Personnel Data," Stephen L. Mehay and Elda Pema (2004) tried to shed light on the issue of career experience and job productivity among males and females in a large hierarchical organization, the Department of Defense (DOD). They used a database of federal employees who were in the workforce in 1986. The Defense Manpower Data Center (DMDC) provided the database, which was restricted to full-time employees, working inside the continental United States, possessing at least a Bachelor's degree, aged between ages 20 and 55, and paid under the GS/GM (General Schedule/General Management) pay system. Because the dataset included homogeneous employees who worked under a single personnel system, the authors argued that it provided potential explanations for gender wage differentials observed in the labor market as a whole, and gender differences in career development, especially the existence of a glass ceiling on promotion in a large personnel system.

Mehay and Pema constructed two performance-rating models and two promotion models. In their performance models, they used two measures of performance as dependent variables: 1) whether an individual ever received the top rating (value=1 or outstanding) during the period 1986-1992; and 2) the average rating level during the same period. In their promotion models, they studied two promotion outcomes: 1) promotion to a higher grade (value of 1 if the individual was promoted at least once during the period 1986-1992); and 2) selection as a supervisor or manager (value of 1 if the employee was ever selected for a supervisory/managerial position). In the performance rating models, Mehay and Pema used explanatory variables for gender (female), race (black, Hispanic, other race), agency (Navy, USMC, USAF, Army) veteran and tenure, while in the promotion models they added prior performance.

They recognized the existence of a potential selection bias problem, since those employees who leave the service may be non-randomly selected. To account for selection, they used a Heckman two-stage technique in the performance rating models and a full maximum-likelihood estimation technique (MLE) in the promotion and supervisor promotion models.

Mehay and Pema found that women receive higher annual performance ratings, have superior promotion rates to those of men, and experience higher salary growth rates over time, and yet are less likely to be promoted to managerial and supervisory positions. They also concluded that a "glass ceiling" might exist in the federal workplace since female employees face constraints on their career progression. However, the discrepancy between men and women in selection to management jobs could be due either to different treatment of the female employees or to individual preferences.

In 1988 DiPrete and Whitman published the study "Gender and Promotion in Segmented Job Ladder Systems." They mentioned the fact that internal labor markets are segmented in various ways (job ladders, ladder groupings, ties), which create boundaries and make overall advancements dependent on such factors as the chances for advancements within a job ladder and the chances to switch to other job ladders. They showed how these contingencies created different career progressions between men and women in the federal civil service during the mid-1970s and how gender promotion differs by job level. In particular, they found that there were no gender differences in the higher and the lower grades. The greatest female disadvantage occurred in the mid grades and especially near the boundary between the upper and the lower grades. In short, they saw that gender difference in promotion rates varies by grade level in a systematic way.

The authors used personnel data for a one-percent sample of white-collar employees of the federal government active between the years 1972 and 1977 and constructed three grade-promotion models: 1) one for the lower grades (GS1-GS4); 2) one for the middle grades (GS5-GS10); and 3) one model for grade promotions in the upper grades (GS11 and higher). They defined the dependent variable as a promotion of one or more grades that occurred within two years of each first entry into a given grade.

As independent variables they used dummy variables for a Bachelor's degree, female, minority, and veteran, and continuous variables for schooling and pre-government work experience (defined by the equation: age - length of government service until the time of reaching the origin grade - years of education – 5 = pre-government work experience). Independent variables also included: years of government service (the years of service prior to attaining the origin grade); first government job; irregular (a dummy variable for whether the employee had begun the career in an irregular, temporary-part time job status); proportion female in the job ladder (an indicator of the extent to which a job ladder is sex-segregated)[1]; the origin grade; the region and the agency of the original grade; a job designation variable; and a dummy variable for temporary leave (takes the value of 1 if a temporary leave or absence was taken during the two-year risk period of promotion).

DiPrete and Soule found that not all women in the federal government were in the same boat in the middle 1970s. Five percent of the women who had reached administrative levels did experience the same rate of advancement as men. To reach that level, women faced three difficulties: 1) a lower entry grade than men; 2) lower advancement rates in the crucial middle grades; and 3) lower- to higher-tier promotions that were harder to obtain even after other factors were controlled.

The authors concluded that there is no necessary relationship between sex segregation and career advancement. What matters is whether women's jobs offer advancements prospects similar to those of men. They suggested that sex-neutral

[1] The sex-segregation approach assumes that unequal initial placement, combined with mobility barriers to subsequent advancement, causes gender inequality. Among the factors that are responsible for the gender differences in advancement is sex segregation, which is the gender difference in distribution across job ladders. (DiPrete and Soule, 1988).

promotion policies will not eliminate gender inequalities, since women and men are hired in different grade levels in the organization. Even if they were hired in similar grade levels, gender differences would still exist, since women have lower advancement opportunities in their job ladders than men. Finally, their analysis showed that older employees have a disadvantage in promotion, which also can be affected by the form of the employment relationship (part-time employees advance slower than full-time employees).

Usan and Utoglu (1999) analyzed job performance of federal employees in their thesis "The Effect of Graduate Education on the Job Performance of Civilian Department of Defense Employees." Their aim was to determine the most important demographic and background factors that influence job performance of DOD civilian employees, focusing on graduate education.

Usan and Utoglu used data drawn from the Department of Defense Civilian Personnel Data Files, provided by the Defense Manpower Data Center (DMDC). The data was restricted to full-time career and career-conditional civilian DOD employees who possessed at least a Bachelor's degree, worked under the General Schedule (GS) or General Management (GM) pay system and worked in the continental U.S. in September 1986. Employees who worked in the National Security Agency, the National Imagery and Mapping Agency and in the Defense Intelligence Agency were excluded. The General Schedule (GS) and General Management (GM) systems were chosen because they are the primary white-collar system, which covers two thirds of the entire defense civilian workforce. The authors' primary research question was to "estimate the effect of graduate education on the job performance of the DOD civilian employees", while their secondary question was to "estimate the payoff to employees and the DOD of advanced education."

Usan and Utoglu used four different performance measures--salary level, promotion, performance rating and retention--to answer the above questions, and they constructed four multivariate models. For the salary model, they estimated semi-log earnings function based on equation (1):

$$Ln\ (Y) = \beta o + \beta X + \varepsilon \qquad (1)$$

where,

Y = annual salary

β o = a constant term

X = a vector that captures background characteristics, such as level of education attainment, federal experience, and other salary determinants

β = a vector of parameters to be estimated

ε = the random error term

They estimated the OLS model in two steps: 1) without controlling for grade levels; and 2) controlling for grade levels. The other independent variables were race, gender, region, education, occupation and supervisory dummies. The authors concluded that: 1) women earn 10.72 percent less than men; 2) minorities earn less than whites; and 3) federal experience is positively correlated to earnings, everything else held constant. After controlling for grade level, they found that having an M.A. does not change the annual salary substantially, while having a Ph.D. degree increases the annual salary by 4.04 percent, compared to Bachelor's degree holders.

For the promotion model, they used a basic logit model given by equation (2):

$$Prob\ (promote)_i = \beta o + \beta X + \varepsilon \qquad (2)$$

where,

Prob $(Promote)_i$ = the probability of promotion for individual i

X = a vector of personal demographics and background characteristics that influence the promotion behavior

β = a vector of coefficients for the X factors

βo = a constant term

ε = the random error term

They suggested that since DOD is a "salary structure" organization, salary is often adjusted more or less automatically. Thus, employees' performance can be more directly measured by looking at the upward movement in the organization hierarchy (promotions). They assumed that promotions, as a measurement of performance, might capture differences between persons not reflected in the salary models.

The authors restricted the data set by excluding federal employees who left DOD by September 1992, since their promotions were not available, and focused instead on the employees who had not attained any additional degree between 1986 and 1992 and were between 22 and 65 years old.

The dependent variable was based on the individual's last promotion and was coded one 1 if the individual was promoted at least one time between 1986 and 1992. As independent variables, they used gender, race, education, occupation, functional area, veteran status, and supervisory and performance ratings. Four different specifications of the basic model were run: 1) one without controls for grade level and performance rating; 2) one with only grade controls added; 3) one with only performance rating added; and 4) one with both grade level and performance rating added.

The authors found that education variables are statistically significant in the promotion probability models, but the effect of education is negative when an individual's grade level is not controlled. The results indicate that advanced degree holders have fewer opportunities to be promoted since they usually occupy initial jobs at higher-grade levels. They also found that females are more likely to be promoted than men, while minorities are less likely to be promoted compared to whites, all other factors remaining constant. Veterans and supervisors are not promoted as fast as non-veterans and non-supervisors and one additional year of federal service decreases the promotion probability, all else being equal.

Retention is the decision to leave or stay in an organization and primarily depends on the individual. Organizations, on the other hand, want to retain the qualified and more capable employees in their workforce in order to increase productivity, reduce manpower and training cost and have a positive return on the training investment they made.

Usan and Utoglu classified the factors that affect retention into four categories: 1) wage effects; 2) cyclical effects; 3) age and job tenure effects; and 4) cost of leaving. They constructed a retention model using the probability to stay as the dependent variable, which is coded 1 if the individual remained as an employee of DOD between the years 1986 and 1992. The explanatory variables in the retention model include sex, race, age, veteran status, functional areas, the number of federal years, and the average performance rating the employees received for the years between 1986 and 1992. Two models were analyzed: one for all employees and one for the new hires in 1986.

Their results, for the model that included all the employees, indicate that women are less likely than men to stay. Each additional year of age at entry reduces the retention rate. Furthermore, a person with one more federal service year is more likely to stay, all else remaining constant. Prior performance rating is positively related to retention while possession of a Master's or PhD degree is negatively related.

The model for the "new hires" indicates that veterans and older workers have higher retention rates, which is consistent with the existing literature that states that older people are less likely to change jobs and younger workers have greater job mobility. Performance rating is positively correlated to retention, while educational variables (MA, PhD) have negative relationships, indicating that in early years of employment people are more likely to change jobs.

Usan and Utoglu pointed out three drawbacks in using performance ratings to measure job productivity: 1) supervisors might be "harsh raters" or "easy raters"; 2) harsh raters give lower than true evaluations while easy raters give higher than true evaluations; 3) supervisors might also be influenced by the employee's personal characteristics (race, sex, tenure) or might not want to give extremely low or high ratings.

The authors created two logit models, one estimated for the employee inventory for the year 1986 and one estimated for the new hires in 1986. The dependent variable was defined as 1 if the average performance rating over the 8-year period (1986-1994) exceeded the mean for the person. The data they used included employees between 22 and 65 who had valid performance ratings and unchanged education attainment between

1986 and 1992 (for the inventory model). As explanatory variables, they used gender, race, supervisor, veteran status, education supervisory status, federal experience, occupational groups, and functional areas.

They concluded that for all occupational groups and functional areas (except other white collar), being a female, veteran supervisor or advanced degree holder are positively correlated with performance, while minority status and more federal years in the service are negatively correlated with being in the top half of the distribution of the performance ratings.

In the “new hire model”, the federal years variable was excluded since it did not have any meaning (all observations were at the beginning of the federal career). The majority of the variables had the expected signs. The only exceptions were that females and veterans were less likely to be in the top half of all performance ratings.

In his study “Pay, Experience, and Productivity: The Government-Sector Case” Bruce H. Dunson (1985) tested the hypothesis that earnings differences among workers is due to experienced workers being more productive. He focused on civilian middle managers and professionals in the Department of Defense and used a relatively unused data source--the Department of Defense Civilian Master and Transaction file that contains data for all civilian DOD employees.

After restricting the data to full-time workers, Dunson used as an index of performance the performance ranking required by the Civil Service Reform Act of 1980, which ranks employees into one of five categories: 1 = outstanding; 2 = exceeds fully successful; 3 = fully successful; 4 = minimally successful; 5 = unsatisfactory. Because very few people were reported as unsatisfactory, only categories 1 through 4 were used in his analysis.

Dunson estimated a standard semi-log earnings model as given by equation (1) above. The independent variables included education, pre-government experience, pre-government experience squared, government experience, government experience squared, performance rating, regional dummies, and grade level. He estimated three models: 1) one with no controls for performance rating and grade level; 2) one with grade-level dummy variables included; and 3) one with both performance rating and grade level variables.

One interesting finding from the first model is the lack of variation in pay by education, especially for Navy Department employees. After Dunson controlled for education, age and region, he found that the more-experienced employees earned more than their less-experienced peers. Two other significant findings emerged from Dunson's analysis. First, Master's and PhD degree holders earned more than those with Bachelor's degrees because they occupied higher grades. Persons who received higher ratings on average earned more than those with lower performance evaluations, but the difference in pay associated with performance evaluation was extremely small, less than 1 to 2 percent. The second and most important finding is that although human capital and earnings are positively correlated, performance does not seem to be positively correlated to human capital.

John Bishop (1987) in his study "The Recognition and Reward of Employee Performance" examined the extent to which an individual's wage depends on his/her relative productivity. He assumed that most hiring selections are based on incomplete information due to the very small investment most employers make in their hiring decisions. The major questions he tried to answer were the following: What parameters explain wage growth, promotions and demotions? What is the effect of a worker's relative productivity on his/her relative wage? To what extent are productivity differentials incorporated into relative wage rates?

Bishop concluded that employers, in general, believe they can rate the productivity (performance) of their employees by adjusting relative wage rates. Performance-based wages produce three kinds of benefits for the firm. They: 1) serve as an incentive for greater effort; 2) attract more capable workers; and 3) reduce the probability of losing the best performers to other firms. However, worker productivity information is difficult and costly to obtain, leading to limits on the adjustments of wage rates to productivity. Bishop addressed six reasons for these limits: 1) the inevitability of significant errors in measuring productivity; 2) the variation in productivity over time;

3) the worker's productivity differentials which are either not visible to other employees or specific to the firm; 4) worker risk aversion; 5) the deferred compensation of performance; and 6) the recognition of productivity in other, non-pecuniary ways (praise, desirable job assignment, greater autonomy, lower likelihood of layoff).

Bishop used retrospective longitudinal data on wage rates, turnover, and reported productivity of a pair of new hires, for the same or similar job, derived from the 1982 National Center for Research in Vocational Education Employer Survey. The first member of the pair was obtained by selecting the last employee the company hired prior to August 1981, while the second member of the pair was chosen by asking the employer to identify "an employee with similar position but with some prior vocational training". The survey collected data from 3412 employers from selected geographic areas across the U.S. Its strategy was to pick firms with a relatively high proportion of low-wage workers and where the respondents were owners or managers and were familiar with the performance of each of the firm's employees.

Bishop defined the dependent variable of the performance model as the deviation of the individual wage from the mean for workers with similar tenure. For independent variables he used: 1) the deviation of the individual's productivity from the mean; 2) the difference between the training individual i needs to perform satisfactorily and that needed by the typical new hire; and 3) differences in credentials, background characteristics, and tenure between the individual and the mean for other new hires. Since no data was available on the mean, he used data on two workers doing the same job.

Bishop found that relative productivity does have important and reasonably rapid effects on related wage rates at small and medium firms but no effect at larger companies where wages responded slowly to productivity. Bishop also presented evidence that wage rate differentials partially reflect variances in productivity for workers with one year of tenure and that there is no immediate response of relative wage rates to productivity in very large establishments. Finally, Bishop suggested that the assumption "individual wages are equal to individual marginal products" must be weakened or replaced by a new hypothesis: "that wages are equal to the average marginal product of all workers with the same tenure." Therefore, when evaluating training programs, we must take under consideration the fact that the true effects on productivity might be different from their effects on earnings.

In his study "Gender and Promotions: Promotion Chances of White Men and Women in Federal White-Collar Employment," Gregory B. Lewis (1986) examined the impact of gender on promotion probabilities for federal white-collar GS employees. The analysis was based on data derived from the Central Personnel Data File (CPDF) for the period from 1973 to 1982, maintained by the U.S. Office of Personnel Management (OPM). The data was restricted to full-time employees of the General Schedule (GS), Merit Pay, or Senior Executive Service (SES) pay systems.

He used a binary dependent variable, which indicated whether the employee was or was not promoted during the year, and specified a standard human capital model. As independent variables he included "years of federal experience" and its squared term, the "pre-government experience" and the "years of education" and their squared terms, veteran preference, age and grade dummy variables.

Lewis found that promotion prospects fall with each level of federal experience more quickly for men than for women. His analysis showed that promotion rates by length of federal service are higher for white males than their female peers when promoted during the first five years of service and lower each year thereafter. Potential experience (the experience the worker has before joining the service) had less impact on promotions for women than for men, but its impact was not as strong as that of federal experience. Furthermore, Lewis concluded that grade level had less impact than initially projected, that promotion prospects were lower at higher grades, and that veteran males seemed to move up faster in the federal hierarchy ladder, compared to the non-veterans. Finally, education was found to have a small effect on promotion probabilities. In general, a variety of indicators suggested that female federal employees have advantages in promotions when compared to their male colleagues.

In her qualitative study "Through the Glass Ceiling: Prospects for the Advancement of Women in the Federal Civil Service," Katherine C. Naff (1994) tried to identify the barriers that exist between men and women in the U.S. federal civil service.

Although gender discrimination has been illegal in the U.S. since 1964, women tend to be underrepresented in managerial ranks. The author examined the factors that account for women's advancements using a unique dataset compiled by the U.S. Merit Systems Protection Board (MSPB). The dataset was collected during the years 1991 and 1992 and contained three sources of information: "hard data" collected on federal employees and maintained in a Central Personnel Data File (CPDF) by the U.S. Office of Personnel Management (OPM), focus groups of middle- and senior-level federal employees, and a government survey of federal employees (Merit System Protection Board, 1992).

Naff discussed the "glass ceiling" as encompassing the nature of barriers that limit women's advancement, and women's opinions about how they are treated in the working environment. She defined five factors that affect career advancement: 1) experience (length of federal service); 2) education; 3) relocation; 4) time developed to the job; and 5) children. Seniority (length of federal service) and education are the two most important human capital variables, according to the author. The longer someone has worked for the government, the greater the number of promotions. Career advancement and the number of geographic relocations are expected to have a positive influence on advancement, along with the time devoted to work. However, women with children are expected to be promoted less than women without children, even after controlling for education, experience and relocation.

Naff concluded that there is a glass ceiling in the federal government. Women are held back and not promoted because of stereotypes and various assumptions unrelated to their stock of human capital. The usual assumption is that employees who deserve a promotion who are the most committed, who relocate as necessary, and who, when needed, put in the longest work hours. If women are not willing to relocate or work late, especially when they have children, they may be treated differently when being considered for career-enhancing assignments and for promotion. On the other hand, stereotypes about women's abilities encourage their promotion slowdown, which causes them to believe that they work in a hostile environment.

A summary of the previous studies on career progression, job performance and retention is presented in Table 4. The table provides information on the key elements of each study, including the data source, empirical methods and key findings.

Table 4. A Summary of the Previous Studies on Career Progression, Job Performance and Retention.

AUTHOR/TOPIC	DATA SOURCE	TECHNIQUES	FINDINGS
Asch (2000) Pay, Promotion and Retention of High-Quality Civil Service Workers	DMDC Personal files	- OLS Regression Models. - COX regression Models	Inconsistent retention results between cohorts. Better educated with higher ratings are paid more and promoted faster.
Mehay and Pema (2004) Gender Differences in Job Performance and Career Progression: Evidence from Personnel Data	DMDC Personnel Data Base	- OLS Regression Models. - Logistic regression Models. -Heckman two stage. -Maximum Likelihood estimation (MLE).	Although women receive higher ratings, have higher salary growth and superior promotion rates, they face constraints in progression (glass ceiling).
DiPrete and Whitman (1988) Gender and Promotion in Segmented Job Ladder Systems	Personnel Data Base	- Logistic regression	There is no necessary relation between sex segregation and career advancement. Older people have disadvantage in promotion.
Usan and Utoglu (1999) The Effect on the Job Performance of Civilian Department of Defense Employee.	DMDC DoD Civilian Data files	- OLS Regression Models - Logistic regression	Education is negatively related to promotion when grade level is not controlled. Females, advanced degree holders, and minorities are less likely to be promoted. Women are retained less and performance rating is a weak way to measure productivity. In new hired cohorts veterans and older workers have higher retention rates. Performance rating is positively correlated to retention while education variables have negative signs.

Dunson (1985) Pay Experience and Productivity: The Government Sector Case	DoD Civilian masters file. Civilian DoD Transaction file.	- OLS Regression Models	Master's, PhD earned more than Bachelor's because they occupied higher grades. Persons who receive higher ratings earn more. Performance is positively correlated with human capital.
Bishop (1987) The Recognition and Reward of Employee Performance	1982 National Center for Research in Vocational Education Survey.	- OLS Regression Models	Relative productivity has no effect on wages at big firms. Evidence that wage differentials partially reflect variances in worker's productivity. Suggests that wages are equal to the average marginal product of all workers with the same tenure.
Lewis (1986) Gender and Promotions: Promotion Chances of White Men and Women in Federal White-Collar Employment	Central Personnel Data File (DPDF).	- Logistic regression	Promotion rates higher for white males than female peers. Promotion prospects are lower at higher grades and education has a small effect on promotion. Female employees have advantage in promotion when compared to males.
Naff (1994) Through the Glass Ceiling: Prospects for the Advancement of Women in the Federal Civil Service	Central Personnel Data File (DPDF). Government survey of Federal Employees 1992.	- OLS Regression Models	Defined five factors that affect career advancement: experience, education, relocation, time devoted to work, children. Concluded there is a glass ceiling for women in the federal government. They are often treated differently in being selected for career-enhancing assignments.

III. DATA, MODELS, AND DESCRIPTIVE STATISTICS

This chapter describes the data set and the methods used to specify and construct multivariate career progression and job performance models. It provides information about the independent and explanatory variables, and presents descriptive statistics of the variables.

A. DATA

The data used for this thesis were drawn from the Department of Defense Civilian Personnel Data Files provided by the Defense Manpower Data Center (DMDC). The data set consisted of civilian employees who were newly hired in 1995. Information was available for each individual from 1995 to 2003. The file was restricted to federal employees who were paid under the GS pay system.

The raw data file included 18,777 observations and 461 variables. The data elements consisted of personal demographics and service background information such as Sex, Race, Age, Agency, Education Level, Veteran Status, Federal Service Years, Functional Areas, Occupational Category (PATCO), Region, Grade Level, Supervisory or Managerial Status, Yearly Compensation, and Performance Rating Evaluations.

Several categories of explanatory variables were used. For the purpose of the thesis, I divided Race into four groups: White, Black, Hispanic and Other Race. I divided Occupational category (PATCO) into six sub-categories: Professional, Administrative, Technical, Clerical, Other White Collar, and Blue-Collar employees. I divided Functional Area into seven groups: Force and Fleet, Intelligence and Communication, Material, Training and Education, Medical, Department Headquarters, and Administrative Activities. I divided Agency into four categories: Navy, Army, Air Force and Other Agent. Finally, I divided Educational Level into four categories: Bachelor's Degree, Master's Degree (MA_MS95), Ph.D. Degree (PhD95), and Other Education (less than bachelor's level). Variable names and variable description of the inventory of new hires that stayed until 2003 are listed in Table 5. Their descriptive statistics are provided in Table 6. Means are calculated for male and females, and for all employees. The last column of Table 6 represents the results of a t-test of difference-in-group means between males and females for each variable. Information about the average progression until year 2003 per grade of entry is provided in Table 7.

Table 5. Variable Names and Variable Description as of Year 1995 (Inventory Data, Only Stayers)

Variable Name	**Variable Description**
Female	1=Female 0=Male
Black	1= Black 0= Not Black
Hispanic	1= Hispanic 0= Not Hispanic
Other_Race	1= Other Race 0= Not Other Race
White*	1= White 0= Not White
Veteran	1= Veteran 0= Not Veteran
Total_Federal_Service_95	Federal Service Experience as of year 1995
Total_Federal_Service_95sq	Federal Service Experience squared as of year 1995
Veter_Fed_Experience	Interaction between the variables: Veteran and Total Federal Experience
Labor_Market_Experience	Labor Market Experience as of year 1995
Labor_Market_Experience_sq	Labor Market Experience squared as of year 1995
Other_Agent	1= Other Agent 0= Not Other Agent
Navy	1= Navy 0= Not Navy
USMC	1= USMC 0= Not USMC
USAF	1= USAF 0= Not USAF
Army*	1= Army 0= Not Army
Bachelor_Degree	1= Individual has a Bachelor’s degree in 1995 0= Individual does not have a Bachelor’s degree in 1995
MA_MS95	1= Individual has a Master’s degree in 1995 0= Individual does not have a Master’s degree in 1995
PhD95	1= Individual has a Ph.D. degree in 1995 0= Individual does not have a Ph.D. degree in 1995
Other_Education*	1= Individual has other education in 1995 0= Individual does not have other education in 1995
Education_Change	Additional years spent by employees, to attain academic degrees during 1995-2003
Grade[1]	Employee’s grade as of year 1995
High_Performance	1= Individual has high performance 0= Individual does not have high performance

Average_Rating[1]	Average performance evaluations during 1995-2003
ONETOP	1= Individual received top rating during 1995-2003 0= Individual did not receive top rating during 1995-2003
Num_Of_Promotions[1]	Total number of grade increase during 1995-2003
Promotion_03	1= Individual promoted at least once during 1995-2003 0= Individual was not promoted during 1995-2003
Supervisor_Promotion	1= Individual promoted to supervisor position 0= Individual was not promoted to supervisor position
Age_95[1]	Individual's age in 1995
Avg_Performance96_98[1]	Average performance evaluation during 1996-1998
Hourly_Compensation[1]	Employee's hourly wage
Compensation_03[1]	Employee's annual salary in 2003
Compensation_95[1]	Employee's annual salary in 1995

Source: DMDC
*= Base group
1=Continuous Variable

Table 6. Descriptive Statistics of DOD Civilian Personnel as of Year 1995 (Inventory Data, Only Stayers)

Variable Definition	ALL		MALE ONLY		FEMALE ONLY		t-test (P-value)
	MEAN	STD.DEV	MEAN	STD.DEV	MEAN	STD.DEV	
High_Performance	0.22	0.41	0.22	0.41	0.21	0.41	0.92
Average_Rating[1]	4.21	0.61	4.21	0.61	4.22	0.61	0.41
ONETOP	0.82	0.38	0.82	0.37	0.82	0.38	0.61
Num_Of_Promotions[1]	2.27	2.21	2.33	2.21	2.21	2.21	0.03**
Promotion_03	0.75	0.42	0.77	0.41	0.74	0.43	0.003***
Compensation_95	$26912	11726	$30,098	12607	$22,896	10039	0.0001***
Supervisor_Promotion	0.17	0.38	0.22	0.41	0.11	0.32	0.0001***
Total_Federal_Service_95[1]	4.47	5.48	4.38	5.43	4.59	5.54	0.199
Education_Change[1]	0.29	1.064	0.32	1.13	0.24	0.96	0.0001***
Female	0.44	0.49	0	0	1	0	
Black	0.14	0.35	0.10	0.31	0.19	0.39	0.0001***
Hispanic	0.05	0.23	0.05	0.22	0.064	0.24	0.05**
Other_Race	0.08	0.27	0.08	0.27	0.08	0.28	0.62
Veteran	0.30	0.46	0.47	0.49	0.08	0.28	0.0001***
Bachelor_Degree	0.21	0.41	0.25	0.43	0.17	0.37	0.0001***
MA_MS95	0.08	0.27	0.10	0.30	0.05	0.22	0.0001***
PhD95	0.014	0.12	0.02	0.14	0.0063	0.07	0.0001***

Other_Agent	0.16	0.37	0.11	0.32	0.23	0.42	0.0001***
Navy	0.18	0.38	0.20	0.40	0.16	0.36	0.0001***
USAF	0.22	0.41	0.24	0.43	0.20	0.40	0.0001***
USMC	0.02	0.14	0.02	0.15	0.01	0.12	0.04**
Grade[1]	7.21	3.14	8.18	3.07	5.98	2.78	0.0001***
Age_95[1]	37.5	8.71	38.5	9.07	36.35	8.06	0.0001***
OBS	5732		3197		2535		

Source: DMDC
1=Continuous Variable.
******* Significant at 0.01 level, ****** Significant at 0.05 level, *Significant at 0.1level

Table 7. Average Grade Growth per Grade of Entry (Only Stayers)

Grade of entry in 1995	Average Grade in 2003	S.D.	Min/Max
5	8.08	2.60	5/14
6	7.97	1.96	6/13
7	11.27	1.90	7/15
8	9.97	1.63	8/14
9	10.90	1.33	9/15
10	10.77	0.88	10/13
11	12.03	0.84	11/15
12	12.53	0.76	12/15
13	13.68	0.73	13/15
14	14.30	0.46	14/15
15	15	0	15/15

Source: Author

Three major indicators of civilian employees' job performances were used: 1) promotion; 2) compensation; and 3) annual performance evaluations. Three separate measures of promotion were used: promotion to a higher grade by year 2003, the total number of promotions between 1995 and 2003, and promotion to a managerial or supervisory position by year 2003. As salary measures, I used the logarithm of total compensation and the logarithm of the hourly compensation. Several measures based on annual appraisals were used. A dummy variable was created for receiving the top rating (ONETOP), average grade, and high performance. Each performance variable is discussed in their sections.

Education_Change is a continuous variable used as independent variable and represents the additional years spent by DOD employees to attain additional academic degrees during the 1995-2003 period. ONETOP takes the value of 1 if the individual ever received the top rating during the 1995-2003 period. Supervisor_Promotion takes the value of 1 if the federal employee ever was promoted to supervisor of a managerial position. Promotion_03 takes the value of 1 if the individual received at least one promotion between the years 1995 and 2003. High_Performance takes the value of 1 if the individual's average number of top rating (ONETOP) is greater than the group's onetop average plus one standard deviation. The log of Hourly_Compensation represents the logarithm of the employee's hourly wage. The log of Compensation_03 represents the logarithm of employee's annual salary for the year 2003. Num_Of_Promotions represents the total number of grade increases the employee received during the 1995-2003 period. Avg_Performance96_98 represents the average performance evaluations the employee received during the period 1996-1998. Average_Rating represents the average performance evaluations the employee received during the period 1996-2003. Labor_Market_Experience represents the working experience the individual had before joining DOD in 1995, calculated as:

Labor_Market_Experience=Age_95-Years of Education-Total_Federal_Service_Years95- 6

The descriptive statistics presented in Table 6 highlight the statistically significant differences between men and women hired as civilian employees in the year 1995. Women represent about 44% of the incoming workforce. The overall promotion rate is 75%, but women are promoted at lower rate (74%) than men (77%) and the difference is statistically significant (p=0.003). Within the sample, 17% are promoted to managerial or supervisor positions, but for women the rate is only 11%, compared to 22% for men, a statistically significant difference (p=0.0001). Women receive less credit for prior federal years of service than men (4.59 years versus 4.38), are younger (36.3 versus 38.5), receive a lower beginning salary ($22,896 versus $30,098), and are hired at a lower entry grade (5.98 versus 8.18).

Table 7 presents employee's average grade growth by grade of entry for the 1995-2003 period. An employee who joined DOD in 1995 at grade 5 received on average 3.08 grade increases until 2003 and his/hers grade becomes 8.08. Similarly, an employee who enters DOD at the seventh grade received 4.27 average promotions by 2003.A more detailed discussion will be provided in chapter IV.

B. MODELS

1. Salary Models

When compensation (salary) is used as a measurement of job performance, there is an assumption that salary is adjusted to match individual performance [Wise, "Personal Attributes," 1975]. Two different salary models are specified: 1) one, which estimates the logarithm of hourly compensation (wage); and 2) one, which estimates the logarithm of annual salary.

a. The Log of Hourly Compensation Model

The (Log of Hourly Compensation) model estimates the determinants of the log of hourly wages of DOD employees hired in 1995 who were still in service in 2003. The model is estimated by OLS regression and estimates the effect of gender, federal and non-federal experience, education, grade, race, veteran and education change on the logarithm of hourly compensation. The dependent variable Hourly_Compensation is based on the formula:

Hourly_Compensation = [Compensation _03/ (Time in hours worked per week*52)]. Descriptive statistics for the Hourly Compensation model are shown in Table 8.

Table 8. Descriptive Statistics for the Log Hourly Compensation Model.

Binary Variables	**Mean**	**S.D**
Female=1 if Female	0.44	0.49
Black=1 if Black	0.14	0.35
Hispanic=1 if Hispanic	0.05	0.23
Other_Race=1 if Other race	0.08	0.27
White (Base group)	0.70	0.45
Veteran=1 If veteran	0.30	0.46
Army (Base group)	0.40	0.49
Navy=1 If Navy	0.18	0.38
USMC=1 If USMC	0.02	0.14
USAF=1 If USAF	0.22	0.41
Other_Agent=1 If Other Agent	0.21	0.41
Bachelor_Degree=1 If Bachelor	0.21	0.41
MA_MS95=1 If Master's	0.08	0.27
PhD95=1 If Ph.D.	0.014	0.12
Other_Education (Base group)	0.68	0.46
CONTINUOUS VARIABLES		
Total_Federal_Service_Years_95	4.47	5.48
Labor_Market_Experience	13.09	9.65

Education_Change	0.58	1.44
Grade (1-15)	7.21	3.14
DEPENDENT VARIABLE		
Log Hourly_Compensation	3.07	0.407
OBS= 5,691		

b. The Log of Annual Compensation Model.

The (Log of Annual Compensation) model includes 5,718 observations and explains the variation of the log of annual compensation for 2003. It uses the same independent variables as in the (Log Hourly Compensation) model. The mean of the log of Annual_ Compensation is 10.71.

2. Promotion Models

Since promotion measures one's career progression [Wise, "Personal Attributes," 1975] I investigated the relationship between promotion and performance rating, education, gender, race, federal experience, non-federal experience, and veteran status. Three promotion related models were constructed: 1) a supervisor promotion model, where the binary dependent variable takes the value of 1 if the employee ever becomes manager or supervisor; 2) a (Promotion) model, where the binary Y variable takes the value of 1 if the employee ever receives a promotion to a higher grade during the 1995-2003 period; and 3) a (Number of Promotions) model, where Y measures the number of promotions between years 1995 - 2003.

a. Supervisor Promotion Model

The probit model regresses the probability of being a supervisor on sex, race, education, federal experience, labor experience, agency, grade, veterans and average rating. Descriptive statistics are presented in Table 9.

Table 9. Descriptive Statistics for the Supervisor Promotion Model

Binary Variables	**Mean**	**S.D**
Female=1 if Female	0.44	0.49
Black=1 if Black	0.14	0.35
Hispanic=1 if Hispanic	0.05	0.23
Other_Race=1 if Other race	0.08	0.27
White (Base group)	0.70	0.45
Veteran=1 If veteran	0.30	0.46
Army (Base group)	0.40	0.49

Navy=1 If Navy	0.18	0.38
USMC=1 If USMC	0.02	0.14
USAF=1 If USAF	0.22	0.41
Other_Agent=1 If Other Agent	0.21	0.41
Bachelor_Degree=1 If Bachelor	0.21	0.41
MA_MS95=1 If Master's	0.08	0.27
PhD95=1 If Ph.D.	0.014	0.12
Other_Education (Base group)	0.68	0.46
CONTINUOUS VARIABLES		
Total_Federal_Service_Years_95	4.48	5.50
Labor_Market_Experience	13.15	9.67
Average_Rating	4.21	0.61
DEPENDENT VARIABLE		
Supervisor_Promotion	0.12	0.32
OBS=5,708		

b. Promotion 2003 Model

The promotion 2003 model analyzes promotion to a higher grade via a probit model. The outcome is coded 1 if the individual advanced to a higher grade during the years 1995-2003. Descriptive statistics are presented in Table 10.

Table 10. Descriptive Statistics for the Promotion 2003 Model

Binary Variables	**Mean**	**S.D**
Female=1 if Female	0.44	0.49
Black=1 if Black	0.14	0.35
Hispanic=1 if Hispanic	0.05	0.23
Other_Race=1 if Other race	0.08	0.27
White (Base group)	0.70	0.45
Veteran=1 If veteran	0.30	0.46
Army (Base group)	0.40	0.49
Navy=1 If Navy	0.18	0.38
USMC=1 If USMC	0.02	0.14
USAF=1 If USAF	0.22	0.41
Other_Agent=1 If Other Agent	0.21	0.41
Bachelor_Degree=1 If Bachelor	0.21	0.41
MA_MS95=1 If Master's	0.08	0.27
PhD95=1 If Ph.D.	0.014	0.12
Other_Education (Base group)	0.68	0.46
CONTINUOUS VARIABLES		

Total_Federal_Service_Years_95	4.48	5.50
Labor_Market_Experience	13.11	9.67
Avg_Performance96_98	4.42	0.65
Grade (1-15)	7.22	3.13
DEPENDENT VARIABLE		
Promotion_03	0.7567	0.429
OBS=5,537		

c. Number of Promotions Model

Hierarchical organizations are often salary structured. Each position is assigned to a grade level, which is connected to a basic salary. From that perspective, the rate of upward movement (number of promotions) may be a measure of performance and may entail useful information about an employee's actual productivity. The model was estimated as OLS. Descriptive statistics for the (Number of Promotions) model are shown in Table 11. The average individual hired in 1995, who stayed until 2003, received slightly over two promotions.

Table 11. Descriptive Statistics for the (Number of Promotions) Model

Binary Variables	**Mean**	**S.D**
Female=1 if Female	0.44	0.49
Black=1 if Black	0.14	0.35
Hispanic=1 if Hispanic	0.05	0.23
Other_Race=1 if Other race	0.08	0.27
White (Base group)	0.70	0.45
Veteran=1 If veteran	0.30	0.46
Army (Base group)	0.40	0.49
Navy=1 If Navy	0.18	0.38
USMC=1 If USMC	0.02	0.14
USAF=1 If USAF	0.22	0.41
Other_Agent=1 If Other Agent	0.21	0.41
Bachelor_Degree=1 If Bachelor	0.21	0.41
MA_MS95=1 If Master's	0.08	0.27
PhD95=1 If Ph.D.	0.014	0.12
Other_Education (Base group)	0.68	0.46
CONTINUOUS VARIABLES		
Total_Federal_Service_Years_95	4.48	5.50
Labor_Market_Experience	13.11	9.67
Avg_Performance96_98	4.42	0.65
Grade (1-15)	7.22	3.13

DEPENDENT VARIABLE		
Num_Of_Promotions	1.69	2.02
OBS=5,537		

3. Performance Models

DOD is an organization with fixed-length employment contracts. The annual performance ratings by supervisors provide the only official measurement of annual performance. Three performance models were created: 1) a (High Performance) probit model where the dependent variable takes the value of 1 if an individual's average performance is greater than the group's average performance by one standard deviation; 2) an OLS regression model where the continuous dependent variable Average Rating is the average performance rating DOD workers received between 1995 and 2003; and 3) a probit model where the dependent variable ONETOP takes the value of 1 if the individual ever received the top rating (value = 5 or 'outstanding') on any rating during the 1995-2003 period. Descriptive statistics of the performance models are presented in Tables 12.

Table 12. Descriptive Statistics for the Performance Models

Binary Variables	**Mean**	**S.D**
Female=1 if Female	0.44	0.49
Black=1 if Black	0.14	0.35
Hispanic=1 if Hispanic	0.05	0.23
Other_Race=1 if Other race	0.08	0.27
White (Base group)	0.70	0.45
Veteran=1 If veteran	0.30	0.46
Army (Base group)	0.40	0.49
Navy=1 If Navy	0.18	0.38
USMC=1 If USMC	0.02	0.14
USAF=1 If USAF	0.22	0.41
Other_Agent=1 If Other Agent	0.21	0.41
Bachelor_Degree=1 If Bachelor	0.21	0.41
MA_MS95=1 If Master's	0.08	0.27
PhD95=1 If Ph.D.	0.014	0.12
Other_Education (Base group)	0.68	0.46
CONTINUOUS VARIABLES		
Total_Federal_Service_Years_95	4.48	5.50
Labor_Market_Experience	13.11	9.67
Grade (1-15)	7.22	3.13

DEPENDENT VARIABLES		
High_Performance	0.27	0.44
ONETOP	0.71	0.44
Average_Rating	4.21	0.67
OBS=5,708		

THIS PAGE INTENTIONALLY LEFT BLANK

IV. RESULTS OF THE STATISTICAL MODELS

A. THE ROLE OF SELECTION

Due to attrition, the number of civilian employees still in the civil service by 2003 is not the same as the number of employees hired in 1995. If those who left service after 1995 are non-randomly selected, then the model's parameters might be biased. A non-random sample selection problem can cause inconsistency in the dependent variables of the econometric models, due to the violation of the random sampling assumption [Heckman, 1979]. Non-random selection problems arise when: 1) we have truncated samples; 2) survey responders fail to provide answers to certain questions, which lead to missing data for the dependent or the independent variables; 3) there is 'incidental' truncation; and 4) using panel data, some people leave the sample due to attrition. [Wooldridge, 2003].

In a truncated regression model we leave out, on the basis of the dependent variable, a subset of the population and we do not observe any related information. Incidental truncation occurs when we do not observe the dependent variable due to the outcome of another variable and we observe only certain outcomes. The truncation of the dependent variable is therefore incidental and corresponds to one part of the sample.

Non-random samples can arise from either exogenous sample selection or endogenous sample selection. When the sample selection is based on independent variables it is called exogenous and it does not cause any bias or inconsistency. When sample selection is based on explanatory variables it is called endogenous and bias always occurs. In the case of endogenous sample selection, further corrective action must be taken.

The employees who leave DOD can possibly belong to two categories: 1) they might be low performers, and have a lower probability of being promoted; or 2) they might be high performers and thus be promoted faster, but are more capable compared to their peers and have more job prospects elsewhere. If the "leavers" are low performers, then all the results based on performance rating are probably upwardly biased; on the other hand, if the "leavers"' are high performers, then we have the opposite effect. Since sample selection is based on dependent variables, I need to account for selection bias. To do so I can use either the Heckman two-stage method to conduct a sample selection correction or the alternative method of the maximum-likelihood probit estimation with selection.

The Heckman selection model [Heckman, 1979] assumes the existence of a regression relationship:

$$Y_j = X_j \beta + U_{1j} \text{ regression equation} \quad (1)$$

However, the dependent variable is not always observed. It is observed for the j element if:

$$S = 1\ [Z_j \gamma + U_{2j} \geq 0] \text{selection equation} \quad (2)$$

where

$$U_1 \sim N(0, \sigma)$$

$$U_2 \sim N(0, 1)$$

$$\text{Corr}(U_1, U_2) = \rho$$

When $\rho \neq 0$, OLS techniques yield biased results and the two-stage Heckman procedure provides consistent, asymptotically efficient estimates for all the parameters in such models. The sample selection problem would not exist if $\rho = 0$. It is assumed that the elements of X and Z are always observed and written as:

$$X\beta = \beta_0 + \beta_1 X_1 + \ldots + \beta_\kappa X_\kappa \text{ and}$$

$$Z\gamma = \gamma_0 + \gamma_1 Z_1 + \ldots + \gamma_m Z_m$$

Where Z is considered exogenous and written as:

$$E(u/x, z) = 0$$

The equation of primary interest is the regression equation (equation 1). The second equation describes the selection process. It states that whether the value of Y for the person will be selected (observed) or not depends on a number of observable factors Z and a random term U that is assumed to be independent of Z. The factors Z should include the independent variables X of the regression equation and at least one more variable (factor) that affects selection but does not affect Y. In other words, for the procedure to work well, Heckman requires that X be a strict subset of Z, any X_i is also an element of Z, and we have no elements of Z that are not also in X. This has two implications: 1) any element that appears as an explanatory variable in the main regression equation should also be an explanatory variable in the selection equation[2]; and 2) at least one element of Z does not belong in X. With the Heckman procedure we find βs as estimates of the entire sample. Since we deal with a subset of the sample, the extra factor/factors will act as proxy/proxies for all the unobserved variables that induce incidental truncation (sample selection).

An alternative to the two-step Heckman procedure using OLS is to use Maximum Likelihood estimation. This method is nonlinear and involves the simultaneous estimation of both equations (regression and selection). According to [Wooldridge, 2003] it is more complicated, as it requires obtaining the joint distribution of Y and S and is best conducted after the two-step Heckman procedure if there is evidence of sample selection. The procedure fits maximum-likelihood probit models with sample selection and assumes that there exists an underlying relationship:

$$Y^*_j = X_j\beta + U_{1j} \quad \text{latent equation} \quad (3)$$

So that we only observe the binary outcome

$$Y^{Probit} = (Y^* > 0) \quad \text{Probit equation.} \quad (4)$$

The dependent variable for observation j is observed if

$$Y^{select}_j = (Z_J\gamma + U_{2j} > 0) \text{ selection equation} \quad (5)$$

where

$$U_1 \sim N(0, 1)$$

$$U_2 \sim N(0, 1)$$

$$Corr(U_1, U_2) = \rho$$

When $\rho \neq 0$, standard probit equations yield biased results. Briefly, the method is to estimate the selection equation by probit, where all exogenous variables appear in the probit equation. Then the Inverse Mills Ratio[3] acts as its own instrument, as it depends only on exogenous variables [Wooldridge, 2003].

---

[2] According to Wooldridge (2003: "…in rare cases it makes sense to exclude elements from the selection equation, including all elements of x in z if not very costly".

[3] Inverse Mills Ratio is term that can be added to a multiple regression model to remove sample selection bias.

B. SELECTION CORRECTION TECHNIQUES

I used the Heckman two-stage technique on the retention margin to account for selection in the OLS models and MLE to account for selection for the probit models. I assumed that workers' decisions to stay or leave DOD are based on their mobility cost, that is, the cost of leaving. Expected returns are affected by the demographic characteristics and by employment opportunities. Retention rates will vary across occupational categories, while promotion rates should not be affected. Similarly, local labor market characteristics should affect the cost of leaving, but not affect promotion outcomes. Therefore, to identify the retention model I used occupation dummies and State dummies as identifying instruments.

C. RESULTS OF SALARY MODELS

Two salary measures (Log of Annual_Compensation and Log of Hourly_ Compensation) were used as job performance indicators. All models were run in two separate steps and then corrected for selection on the retention margin. In the first step, the models were estimated without grade. In the second step, grade was added. All models were then corrected for selection using the Heckman two-step procedure. Results of the Annual_Compensation model are presented in Table 13 and the Hourly_Compensation model in Table 14. The retention models used in the Heckman correction procedures are presented in Appendix A.

The overall significance of the salary models is explained by the coefficient of determination (R^2), the proportion of the total variation in Y explained by the variation in the explanatory variables. In the salary models, the R^2 indicates that 66.2% of the variation of the Log Compensation_03 Model and 65% of the variation of the Log Hourly_Compensation Model are explained by the variation of the explanatory variables. Other measures of goodness of fit (the overall significance of the models (F-value) and the significance of the individual coefficients) are also tested. The majority of the independent variables are statistically significant. The models have an F-value of 589.27(Compensation_03 Model) and 565.72 (Hourly_Compensation Model) and a prob>F less than 0.0001. As a result, the F-test rejects the null hypothesis that all the coefficients of the independent variables are equal to zero and concludes that the models have explanatory power. In column 3 of Tables 13 and 14 the lambda term is significant at 5% level for both models pointing to the existence of selection bias. The negative sign of lambda suggests that the unobserved factors predicting relations are negatively correlated with salary.

Table 13. Log of Annual_Compensation Model (OLS)

Independent Variables	**Model (1) OLS**	**Model (2) OLS**	**Heckman Model**
Female	-0.2221	-0.0789	-0.0515
	(0.0105)***	(0.0079)***	(0.0092)***
Black	-0.0925	-0.0166	-0.0212
	(0.0133)***	(0.0097)*	(0.0109)*
Hispanic	-0.1023	-0.0340	-0.0693
	(0.0197)***	(0.0142)**	(0.0168)***
Other_Race	-0.1128	-0.0203	-0.0477
	(0.0166)***	(0.0120)*	(0.0141)***
Veteran	0.0356	0.0214	-0.0150
	(0.0153)**	(0.0110)*	(0.0131)
Veter_Fed_Experience	-0.0078	-0.0033	0.0005
	(0.0018)***	(0.0013)***	(0.0015)
Total_Federal_Service_Years_95	-0.0041	-0.0121	-0.0205
	(0.0024)*	(0.0018)***	(0.0021)***
Total_Federal_Service_Years_95sq	0.0006	0.0003	0.0006
	(0.0001)***	(0.0001)***	(0.0001)***
Labor_Market_Experience_sq	-13 E-06	0.0002	0.0004
	(0.0001)	(0.000036)***	(0.000044)***
Labor_Market_Experience	-0.0030	-0.0165	-0.0240
	(0.0016)*	(0.0012)***	(0.0015)***
Other_Agent	-0.1869	-0.0922	-0.0548
	(0.0134)***	(0.0098)***	(0.0115)***
Navy	0.0548	0.0246	0.0355
	(0.0129)***	(0.0093)***	(0.0107)***
USMC	0.0127	-0.0149	0.0032
	(0.0326)	(0.0235)	(0.0268)
USAF	0.0151	-0.0369	-0.0347
	(0.0127)	(0.0092)***	(0.0105)***

Bachelor_Degree	0.3147	0.1178	0.0919
	(0.0119)***	(0.0090)***	(0.0106)***
MA_MS95	0.3803	0.0638	0.0475
	(0.0173)***	(0.0132)***	(0.0154)***
PhD95	0.5649	0.0583	0.0957
	(0.0380)***	(0.0283)**	(0.0322)***
Education_Change	0.0517	0.0201	0.0086
	(0.0047)***	(0.0034)***	(0.0041)**
Grade		0.0938	0.0880
		(0.0013)***	(0.0016)***
Constant	10.7668	10.2469	10.5773
	(0.0169)***	(0.0142)***	(0.0351)***
Observations	5718	5718	13512
F	172.47	589.27	
Prob>F	0.0000	0.0000	
R-squared	0.35	0.66	
Lambda			-0.258
			(0.024)**
ρ(rho)			-0.80

******* Significant at 0.01 level ****** Significant at 0.05 level* Significant at 0.1 level
Standard errors in parenthesis

Table 14. Log of Hourly_Compensation Model (OLS)

Independent Variables	**Model (1) OLS**	**Model (2) OLS**	**Heckman Model**
Female	-0.1896	-0.0465	-0.0230
	(0.0103)***	(0.0076)***	(0.0087)***
Black	-0.0898	-0.0155	-0.0194
	(0.0131)***	(0.0094)	(0.0104)*
Hispanic	-0.1015	-0.0348	-0.0648
	(0.0193)***	(0.0138)**	(0.0158)***
Other_Race	-0.1120	-0.0224	-0.0454
	(0.0163)***	(0.0117)*	(0.0133)***
Veteran	0.0171	0.0035	-0.0278
	(0.0150)	(0.0107)	(0.0124)**

Veter_Fed_Experience	-0.0067	-0.0023	0.0010
	(0.0017)***	(0.0013)*	(0.0014)
Total_Federal_Service_ Years_95	-0.0062	-0.0145	-0.0217
	(0.0024)***	(0.0017)***	(0.0020)***
Total_Federal_Service_ Years_95sq	0.0006	0.0004	0.0006
	(0.0001)***	(0.0001)***	(0.0001)***
Labor_Market_Experience_sq	-0.000013	0.0002	0.0004
	(0.000049)	(0.000035)***	(0.000042)***
Labor_Market_Experience	-0.0014	-0.0148	-0.0212
	(0.0016)	(0.0011)***	(0.0014)***
Other_Agent	-0.1229	-0.0306	0.0016
	(0.0132)***	(0.0095)***	(0.0109)
Navy	0.0394	0.0087	0.0175
	(0.0127)***	(0.0091)	(0.0101)*
USMC	-0.0142	-0.0420	-0.0264
	(0.0320)	(0.0229)*	(0.0254)
USAF	0.0015	-0.0509	-0.0495
	(0.0124)	(0.0089)***	(0.0099)***
Bachelor_Degree	0.3253	0.1317	0.1101
	(0.0117)***	(0.0088)***	(0.0100)***
MA_MS95	0.3938	0.0795	0.0657
	(0.0170)***	(0.0129)***	(0.0145)***
PhD95	0.5828	0.0781	0.1102
	(0.0374)***	(0.0276)***	(0.0306)***
Education_Change	0.0535	0.0224	0.0127
	(0.0046)***	(0.0033)***	(0.0039)***
Grade		0.0929	0.0880
		(0.0013)***	(0.0015)***
Constant	3.1005	2.5880	2.8686
	(0.0166)***	(0.0138)***	(0.0330)***
Observations	5691	5691	13485
F	151.19	565.72	
Prob>F	0.0000	0.0000	

R-squared	0.32	0.65	
Lambda			-0.21
			(0.022)**
ρ(rho)			-0.74

*** Significant at 0.01 level ** Significant at 0.05 level * Significant at 0.1level

Standard errors in parenthesis

Most of the explanatory variables have the expected signs and are significant at the 1% level. The first column (Model 1) of Table 13 indicates that females are paid 22.21% less than males, minorities are paid less than their white peers (black -9.25%, Hispanic -10.23%, other races -11.28%), and that veterans receive higher annual compensation (+3.56%) than non-veterans. Prior federal and non-federal experiences both have a negative effect on annual salary and are significant at the 10% level. When “Grade” is added in model 2, females receive 7.8% less annual compensation, minorities still get paid less (black -1.6%, Hispanic -3.4%, and other races 2.03%); veterans are paid 2.14% more, and federal experience and non-federal experience become significant at the 1% level. For an employee with ten years of prior federal experience, one additional year of prior federal experience reduces annual compensation by 0.61% (-0.0121+(2*0.0003)*10) while for an employee with ten years of non-federal experience one additional year of non-federal experience reduces annual compensation by 1.25% (-0.0165+(2*0.0002)*10), all else remaining the same. All education variables are significant: a Bachelor’s degree increases annual compensation by 11.7%, a Master’s degree by 6.3% and a PhD by 5.8%. The third column “Heckman model” of Table 13 presents the results after accounting for selection bias. After the selection correction, females are still paid less than men (-5.15%), minorities are paid less than whites (black -2.12%, Hispanic -6.93%, other race -4.77%), and labor market experience and prior federal experience have a negative effect on annual compensation. Graduate and postgraduate education increase annual salary by 9.19% for a Bachelor’s, 4.75% for a Master’s and 9.57% for a PhD.

The “Hourly_Compensation Log Model” in Table 14 indicates that being female or belonging to a minority group has a negative effect on hourly compensation. On an hourly basis, and after selection correction (in column 3), females are paid 2.3% less than males. Blacks are paid 1.94% less, Hispanics 6.48% less and members of "other" minorities 4.54% less than whites. Veterans get 2.78% less than non-veterans. When employees have ten years of federal or non-federal experience one additional year of prior federal and non-federal experience reduce hourly salary by 0.97%[4] and 1.32%[5], respectively. A Bachelor's degree increases annual earnings by 11.01%, a Master's degree by 6.57%, and a PhD by 11.02%.

The salary model results are consistent with other study results mentioned in Chapter II. Like Asch (2000) and Dunson (1985), the results indicate that more-educated employees are paid more than less-educated employees.

D. RESULTS OF PERFORMANCE MODELS

Three performance measures (Average_Rating, ONETOP, and High_Performance) were used to estimate job productivity. All models were estimated in two separate specifications and then corrected for selection on the retention margin. The Heckman two-step technique was used for the Average_Rating Model and probit maximum likelihood estimation methods (MLE) were used for the ONETOP and High_Performance models. Partial effects for the probit models were then calculated. Results are presented in Tables 15, 16, 17. Table 18 shows the partial effects[6] of the probit performance models. Since the Heckman model of the ONETOP probit model is insignificant (Prob>Chi2=0.79), model (2) of Table 16 was used to calculate partial effects. For the High-performance probit model, the Heckman model of Table 17 was used (Prob>Chi2=0.04).

The probit retention models used in Heckman corrections are presented in Appendix A.

---

4 -0.0217+(2*(0.0006)*10)=-0.0097=-0.97%

5 -0.0212+(2*(0.0004)*10)=-0.0132=-1.32%

6 Partial Effect is the effect of an explanatory variable on the dependent variable, holding other factors in the regression model fixed.

Table 15. Average_Rating OLS Model

Independent Variables	Model (1) OLS	Model (2) OLS	Heckman corrected Model
Female	0.0354	0.0831	0.0798
	(0.0153)**	(0.0157)***	(0.0163)***
Black	-0.0525	-0.0264	-0.0259
	(0.0194)***	(0.0193)	(0.0193)
Hispanic	-0.0172	0.0059	0.0100
	(0.0286)	(0.0283)	(0.0289)
Other_Race	-0.1079	-0.0763	-0.0731
	(0.0241)***	(0.0240)***	(0.0244)***
Veteran	0.0634	0.0597	0.0638
	(0.0223)***	(0.0220)***	(0.0227)***
Veter_Fed_Experience	-0.0071	-0.0058	-0.0063
	(0.0026)***	(0.0026)**	(0.0026)**
Total_Federal_Service_Years_95	0.0014	-0.0013	-0.0003
	(0.0035)	(0.0035)	(0.0038)
Total_Federal_Service_Years_95sq	0.0001	-0.0000053	-0.00000673
	(0.0002)	(0.0002)	(0.0002)
Labor_Market_Experience_sq	0.0077	0.0031	0.0040
	(0.0023)***	(0.0023)	(0.0027)
Labor_Market_Experience	-0.0002	-0.0001	-0.0002
	(0.0001)***	(0.0001)*	(0.0001)*
Other_Agent	-0.6475	-0.6155	-0.6201
	(0.0195)***	(0.0195)***	(0.0205)***
Navy	-0.7990	-0.8084	-0.8098
	(0.0188)***	(0.0186)***	(0.0187)***
USMC	-0.7595	-0.7669	-0.7692
	(0.0474)***	(0.0469)***	(0.0469)***
USAF	-0.7303	-0.7560	-0.7553
	(0.0175)***	(0.0175)***	(0.0175)***
Bachelor_Degree	0.0139	-0.0472	-0.0445
	(0.0173)	(0.0178)***	(0.0182)**
MA_MS95	0.0751	-0.0246	-0.0232

	(0.0251)***	(0.0261)	(0.0262)
PhD95	0.1200	-0.0420	-0.0470
	(0.0553)**	(0.0563)	(0.0566)
Grade		0.0307	0.0314
		(0.0026)***	(0.0028)***
Constant	4.5795	4.4077	4.3684
	(0.0247)***	(0.0283)***	(0.0611)***
Observations	5708	5708	13508
F	177.91	180.13	
Prob>F	0.0000	0.0000	
R-squared	0.35	0.36	
Lambda			0.030
			(0.042)**
P (rho)			0.061

******* Significant at 0.01 level ****** Significant at 0.05 level * Significant at 0.1level
Standard errors in parenthesis

Table 16. ONETOP Probit Model

Independent Variables	**Model (1) Probit**	**Model (2) Probit**	**MLE Model**
Female	0.1183	0.2686	0.2634
	(0.0478)**	(0.0507)***	(0.0549)***
Black	-0.1506	-0.0889	-0.0884
	(0.0606)**	(0.0614)	(0.0614)
Hispanic	-0.1442	-0.0947	-0.0883
	(0.0883)	(0.0889)	(0.0924)
Other_Race	-0.2411	-0.1566	-0.1516
	(0.0705)***	(0.0716)**	(0.0743)**
Veteran	0.2985	0.2900	0.2961
	(0.0708)***	(0.0721)***	(0.0757)***
Veter_Fed_Experience	-0.0299	-0.0254	-0.0261
	(0.0080)***	(0.0081)***	(0.0085)***
Total_Federal_Service_Years_95	0.0052	-0.0033	-0.0018
	(0.0108)	(0.0109)	(0.0125)

Total_Federal_Service_Years_95sq	0.0002	-0.0000	-0.0001
	(0.0005)	(0.0005)	(0.0005)
Labor_Market_Experience_sq	0.0047	-0.0081	-0.0067
	(0.0072)	(0.0074)	(0.0092)
Labor_Market_Experience	-0.0002	0.0001	0.0000
	(0.0002)	(0.0002)	(0.0003)
Other_Agent	-1.1125	-1.0439	-1.0503
	(0.0613)***	(0.0623)***	(0.0662)***
Navy	-0.8530	-0.8932	-0.8948
	(0.0612)***	(0.0622)***	(0.0623)***
USMC	-0.8756	-0.9190	-0.9220
	(0.1352)***	(0.1366)***	(0.1368)***
USAF	-0.8957	-0.9924	-0.9908
	(0.0580)***	(0.0597)***	(0.0603)***
Bachelor_Degree	-0.0014	-0.1926	-0.1876
	(0.0538)	(0.0573)***	(0.0607)***
MA_MS95	0.1319	-0.1805	-0.1773
	(0.0809)	(0.0868)**	(0.0877)**
PhD95	0.6674	0.1803	0.1731
	(0.2509)***	(0.2578)	(0.2593)
Grade		0.0911	0.0922
		(0.0085)***	(0.0094)***
Constant	1.4863	1.0096	0.8068
	(0.0807)***	(0.0916)***	(0.04)***
Observations	5708	5708	13502
R-squared	0.09	0.11	
Chi-square		620.84	
Pr>Chi2		<0.0001	

-2Log L		4698.101	
ρ(rho)			0.046
Prob>Chi2			0.79

******* Significant at 0.01 level****** Significant at 0.05 level * Significant at 0.1level
Standard errors in parenthesis

Table 17. High_Performance Probit Model

Independent Variables	**Model (1) Probit**	**Model (2) Probit**	**MLE Model**
Female	0.0732	0.1696	0.1077
	(0.0490)	(0.0506)***	(0.0497)**
Black	-0.0888	-0.0249	-0.0835
	(0.0608)	(0.0616)	(0.0591)
Hispanic	-0.0039	0.0576	-0.0450
	(0.0895)	(0.0905)	(0.0891)
Other_Race	-0.2072	-0.1454	-0.2295
	(0.0842)**	(0.0851)*	(0.0818)***
Veteran	0.2985	0.2558	0.2112
	(0.0658)***	(0.0664)***	(0.0794)***
Veter_Fed_Experience	-0.0343	-0.0302	-0.0267
	(0.0082)***	(0.0082)***	(0.0090)***
Total_Federal_Service_Years_95	0.0146	0.0150	0.0043
	(0.0111)	(0.0111)	(0.0119)
Total_Federal_Service_Years_95sq	0.0002	-0.0001	0.0005
	(0.0005)	(0.0005)	(0.0005)
Labor_Market_Experience_sq	-1.2466	-1.2182	
	(0.0631)***	(0.0643)***	
Labor_Market_Experience	-2.0143	-2.0607	
	(0.0956)***	(0.0965)***	
Other_Agent	-1.9052	-1.9341	-1.1416
	(0.2474)***	(0.2450)***	(0.0951)***
Navy	-1.6335	-1.7205	-1.9177
	(0.0669)***	(0.0689)***	(0.1248)***
USMC	0.1088	-0.0040	-1.7988
	(0.0541)**	(0.0560)	(0.2519)***

USAF	0.2099	-0.0047	-1.5875
	(0.0787)***	(0.0832)	(0.0827)***
Bachelor_Degree	0.4009	0.0297	0.0753
	(0.1612)**	(0.1684)	(0.0553)
MA_MS95		0.0694	0.1677
		(0.0083)***	(0.0798)**
PhD95	-0.2325	-0.7211	0.3915
	(0.0561)***	(0.0811)***	(0.1569)**
Grade	0.0732	0.1696	
	(0.0490)	(0.0506)***	
Constant	-0.0888	-0.0249	0.0986
	(0.0608)	(0.0616)	(0.1644)
Observations	5708	5708	13502
R-squared	0.26	0.26	
Chi-square		1673.5810	
Pr>Chi2		<0.0001	
-2Log L		4352.315	
ρ(rho)			-0.33
Prob>Chi2			0.04

******* Significant at 0.01 level ****** Significant at 0.05 level * Significant at 0.11
Standard errors in parenthesis

Table 18. Partial Effects of Probit Performance Models

Variables	**Models**	
	ONETOP	**High_Performance**
Female	0.05962***	0.03264**
Black	-0.02073	-0.0247
Hispanic	-0.02233	-0.0134
Other_Race	-0.03780**	-0.0644***
Veteran	0.06158***	0.06641***
Veter_Fed_Experience	-0.0057***	-0.0080***
Total_Federal_Service_Years_95	-0.00075	0.00130
Total_Federal_Service_Years_95sq	-4.69E-07	0.00014
Labor_Market_Experience	-0.0018	

Labor_Market_Experience_sq	1.95734E-05	
Other_Agent	-0.3143***	-0.2606***
Navy	-0.2585***	-0.3376***
USMC	-0.2948***	-0.2345*
USAF	-0.2840***	-0.3127
Bachelor_Degree	-0.0459***	0.02322
MA_MS95	-0.044**	0.05348*
PhD95	0.0369	0.13360
Grade	0.02054***	

******* Significant at 0.01 level ****** Significant at 0.05 level * Significant at 0.1level
Source of ONETOP probit model: Column 2 of Table 16
Source of High_Performance probit model: Column 3 of Table 17

The goodness-of-fit in the probit models can be examined with the -2 log L value. Very similar to the F value used in OLS, -2 log L value tests the null hypothesis that all coefficients are zero. The overall significance of every one of the performance models is less than 0.001 ($p<0.0001$). As a result, I reject the null hypothesis and conclude that all the models have explanatory power.

No selection bias problem was identified through Heckman's procedures in the ONETOP Model. The lambda term of the Heckman correction for the Average_Rating Model is significant at the 5% level. The results indicated that females perform better than men. After controlling for education and grade, females receive 0.079 higher average rating on a 5-level rating scale (Average_Rating Model). Also, the predicted probability of receiving one outstanding rating is 0.059 (on a scale 0-1) greater than that of men (ONETOP Model), and the predicted probability to be a high performer is 0.032 (on a scale 0-1) higher than for men (High_Performance Model)[7]. Furthermore, considering only the significant variables, the models indicate that "other" races (non-black, non-Hispanic) perform worse than whites. In most cases, experience (prior federal and non-federal) is insignificant. The results for the education variables are inconsistent.

[7]Logistic regression models the log of the odds (Pi / (1- Pi), of the event Y_i =1, where Pi is the probability that Yi =1. The intercept of a logistic regression gives the log odds of Yi =1 for the case where all predictor variables are at their base line. We predict the probability by predicting the logia and then transforming back to a probability based on the formula: Pi= 1/ (1+exp (- (β_0 +β_ι))), β_0= intercept, βι=the coefficient of X_i variable.

A Bachelor's degree reduces worker's average rating by 0.044 (on a scale 0-5), and reduces the predicted probability of receiving ONETOP rating by 0.0459 (on a scale 0-1), while a Master's degree reduces the predicted probability of receiving ONETOP rating by 0.044.

The results are consistent with those of earlier studies mentioned in Chapter II. Similar to the results in Mehay and Pema (2004), females receive higher ratings than men and performance does not seem to be positively correlated to human capital [Dunson, 1985]. The majority of the education variables are insignificant, some have positive signs whereas some have negative ones. The fact that education variables do not seem to have a uniform effect on performance opposes the general belief that education improves employees' job fit and as a result their performance. It could be also be the case, as suggested by Usan and Utoglu (1999), that subjective performance ratings may be a weak way to measure actual productivity.

E. RESULTS OF PROMOTION MODELS

Three promotion models (Supervisor_Promotion, Promotion_03 and Num_Of_ Promotions) were estimated in two separate steps and then corrected for selection on the retention margin. In the first step, the Num_Of_Promotions and Promotion_03 models were estimated while omitting grade, while the Supervisor_Promotion model was estimated without average rating. In the second step, grade and average rating variables were added. In the third and final step, I conducted Heckman corrections and found that all models needed to be corrected for selection, since the 'lambda' term is significant at the 1% level for the Num_Of_Promotions Model, and the rho term is significant in the

Supervisor_Promotion and Promotion_03 models. Results are presented in Tables 19, 20, and 21. Table 22 shows the partial effect of the promotion probit models. The retention models used in the Heckman corrections are presented in Appendix A.

The coefficients of female and minority variables (where significant) are negative, as expected. Females receive 0.20 fewer promotions than males (on a 0-8 scale). The predicted probability of receiving at least one promotion during the period 1995-2003 (Promotion_03 model) is 0.018 lower for females than for men. Like females, minorities (black, Hispanic, and other race) are promoted less. Compared to whites, the predicted probability for a Hispanic to become a supervisor is 0.0776 less and, for the other races, 0.068 less, all else remaining constant .

All else being the same, having a Bachelor's degree increases the total number of promotions during this period by 0.93 (1-8 scale), and the predicted probability of receiving at least one promotion during the 1995-1003 period by 0.024. Having a Master's degree increases the total number of promotions by 0.49. Finally, a Ph.D. increases the total number of promotions by 0.51 and the predicted probability of becoming a supervisor by 0.0691.

Table 19. Promotion_03 Probit Model

Independent Variables	**Model (1) Probit**	**Model (2) Probit**	**Heckman corrected Model**
Female	-0.0863	-0.2605	-0.1225
	(0.0448)*	(0.0476)***	(0.0369)***
Black	-0.0762	-0.1582	-0.1111
	(0.0558)	(0.0567)***	(0.0437)**
Hispanic	-0.1613	-0.2360	-0.2744
	(0.0810)**	(0.0822)***	(0.0652)***
Other_Race	-0.0848	-0.1831	-0.2224
	(0.0687)	(0.0701)***	(0.0553)***
Veteran	0.2786	0.2760	-0.0166
	(0.0627)***	(0.0633)***	(0.0498)
Veter_Fed_Experience	-0.0312	-0.0341	-0.0071
	(0.0071)***	(0.0072)***	(0.0056)
Total_Federal_Service_Years_95	-0.0432	-0.0399	-0.0504
	(0.0101)***	(0.0103)***	(0.0078)***
Total_Federal_Service_Years_95sq	0.0005	0.0008	0.0013
	(0.0005)	(0.0005)*	(0.0004)***
Labor_Market_Experience_sq	-0.0740	-0.0646	-0.0451
	(0.0072)***	(0.0074)***	(0.0055)***
Labor_Market_Experience	0.0010	0.0008	0.0006
	(0.0002)***	(0.0002)***	(0.0002)***
Other_Agent	0.0070	-0.0365	0.0810
	(0.0593)	(0.0598)	(0.0448)*

Navy	0.1210	0.1760	0.1706
	(0.0562)**	(0.0573)***	(0.0449)***
USMC	-0.0598	0.0012	0.0168
	(0.1323)	(0.1356)	(0.1043)
USAF	-0.0322	0.0728	0.0198
	(0.0510)	(0.0523)	(0.0416)
Avg_Performance96_98	0.0919	0.1818	0.1381
	(0.0311)***	(0.0323)***	(0.0225)***
Bachelor_Degree	0.0670	0.2615	0.1774
	(0.0522)	(0.0556)***	(0.0443)***
MA_MS95	-0.1937	0.1024	0.0554
	(0.0714)***	(0.0767)	(0.0610)
PhD95	-0.6366	-0.1866	0.0408
	(0.1453)***	(0.1511)	(0.1121)
Grade		-0.0927	-0.0837
		(0.0077)***	(0.0058)***
Constant	1.2497	1.4453	1.9396
	(0.1607)***	(0.1640)***	(0.1178)***
Observations	5537	5537	13331
ρ(rho)			-0.97
			Prob>chi2=0

*** Significant at 0.01 level ** Significant at 0.05 level * Significant at 0.1level
Standard errors in parenthesis

Table 20. Supervisor_Promotion Probit Model

Independent Variables	**Model (1) Probit**	**Model (2) Probit**	**Heckman corrected Model**
Female	-0.3453	-0.3488	0.0261
	(0.0470)***	(0.0473)***	(0.0323)
Black	-0.0953	-0.0756	-0.0006
	(0.0613)	(0.0618)	(0.0385)
Hispanic	-0.0619	-0.0578	-0.1951
	(0.0885)	(0.0890)	(0.0604)***
Other_Race	-0.2497	-0.2082	-0.1722
	(0.0786)***	(0.0791)***	(0.0501)***
Veteran	0.2254	0.2139	-0.0338
	(0.0647)***	(0.0651)***	(0.0453)

Veter_Fed_Experience	-0.0212	-0.0190	0.0089
	(0.0075)***	(0.0076)**	(0.0052)*
Total_Federal_Service_Years_95	0.0217	0.0213	-0.0233
	(0.0106)**	(0.0107)**	(0.0069)***
Total_Federal_Service_Years_95sq	0.0001	0.0001	0.0008
	(0.0005)	(0.0005)	(0.0003)***
Labor_Market_Experience_sq	0.0291	0.0274	-0.0247
	(0.0074)***	(0.0074)***	(0.0047)***
Labor_Market_Experience	-0.0008	-0.0007	0.0006
	(0.0002)***	(0.0002)***	(0.0001)***
Other_Agent	0.0420	0.2258	0.3053
	(0.0621)	(0.0674)***	(0.0418)***
Navy	0.1029	0.3531	0.2906
	(0.0577)*	(0.0671)***	(0.0415)***
USMC	0.5375	0.7817	0.5008
	(0.1276)***	(0.1319)***	(0.0942)***
USAF	0.4087	0.6346	0.3209
	(0.0510)***	(0.0600)***	(0.0409)***
Bachelor_Degree	0.2135	0.2158	-0.0039
	(0.0513)***	(0.0517)***	(0.0350)
A_MS95	0.2997	0.2804	0.0232
	(0.0706)***	(0.0710)***	(0.0510)
PhD95	0.1597	0.1280	0.1752
	(0.1608)	(0.1614)	(0.1053)*
Average_Rating		0.3142	0.1854
		(0.0418)***	(0.0253)***
Constant	-1.3082	-2.7643	-0.7048
	(0.0775)***	(0.2107)***	(0.1328)***
Observations	5731	5708	10261
ρ(rho)			-0.98
			Prob>chi2=0.00

*** Significant at 0.01 level ** Significant at 0.05 level * Significant at 0.1level
Standard errors in parenthesis

Table 21. The Number of Promotions OLS Model

Independent Variables	**Model (1) OLS**	**Model (2) OLS**	**Heckman corrected Model**
Female	-0.1018	-0.2674	-0.2032
	(0.0443)**	(0.0470)***	(0.0781)***
Black	-0.0703	-0.1468	-0.2712
	(0.0552)	(0.0560)***	(0.0875)***
Hispanic	-0.1656	-0.2356	-0.6077
	(0.0802)**	(0.0813)***	(0.1367)***
Other_Race	-0.0519	-0.1434	-0.5371
	(0.0685)	(0.0699)**	(0.1125)***
Veteran	0.2754	0.2726	0.2014
	(0.0623)***	(0.0629)***	(0.1031)*
Veter_Fed_Experience	-0.0294	-0.0321	-0.0125
	(0.0071)***	(0.0072)***	(0.0121)
Total_Federal_Service_Years_95	-0.0422	-0.0390	-0.1717
	(0.0101)***	(0.0102)***	(0.0167)***
Total_Federal_Service_Years_95sq	0.0005	0.0008	0.0040
	(0.0005)	(0.0005)*	(0.0007)***
Labor_Market_Experience_sq	-0.0692	-0.0597	-0.2111
	(0.0071)***	(0.0072)***	(0.0124)***
Labor_Market_Experience	0.0009	0.0007	0.0039
	(0.0002)***	(0.0002)***	(0.0004)***
Other_Agent	-0.0095	-0.0511	-0.1927
	(0.0586)	(0.0591)	(0.0936)**
Navy	0.1261	0.1778	0.3569
	(0.0557)**	(0.0567)***	(0.0862)***
USMC	-0.0339	0.0248	0.3736
	(0.1319)	(0.1350)	(0.2126)*
USAF	-0.0255	0.0744	0.1490
	(0.0505)	(0.0518)	(0.0823)*
Avg_Performance96_98	0.0944	0.1795	0.0884
	(0.0307)***	(0.0319)***	(0.0559)
Bachelor_Degree	0.0822	0.2676	0.9313
	(0.0516)	(0.0549)***	(0.0829)***

MA_MS95	-0.1889	0.0943	0.4966
	(0.0708)***	(0.0760)	(0.1211)***
PhD95	-0.6716	-0.2411	0.5132
	(0.1445)***	(0.1503)	(0.2591)**
Grade		-0.0885	-0.3187
		(0.0076)***	(0.0127)***
Constant	1.1569	1.3390	7.8827
	(0.1585)***	(0.1615)***	(0.4393)***
Observations	5537	5537	10023
λ			2.28***
ρ(rho)			-0.90

******* Significant at 0.01 level ****** Significant at 0.05 level * Significant at 0.1level
Standard errors in parenthesis

Table 22. Partial Effects of Probit Promotion Models

Variables	**Models**	
	Promotion_03	**Supervisor_Promotion**
Female	-0.01827***	0.01038
Black	-0.01749**	-0.00022
Hispanic	-0.04844***	-0.07765***
Other_Race	-0.0377***	-0.06860***
Veteran	-0.00249	-0.01346
Veter_Fed_ Experience_95	-0.0010	0.0035*
Total_Federal_Service_Years_95	-0.752**	-0.0092***
Total_Federal_Service_Years_95sq	0.00019***	0.00032***
Labor_Market_Experience	-0.006738***	-0.0098***
Labor_Market_Experience_SQ	0.000093***	0.00025***
Other_Agent	0.01171*	0.1199***
Navy	0.02361***	0.1143***
USMC	0.0024	0.1894***
USAF	0.00292	0.1260***
Avg_Performance96_98	0.02061***	

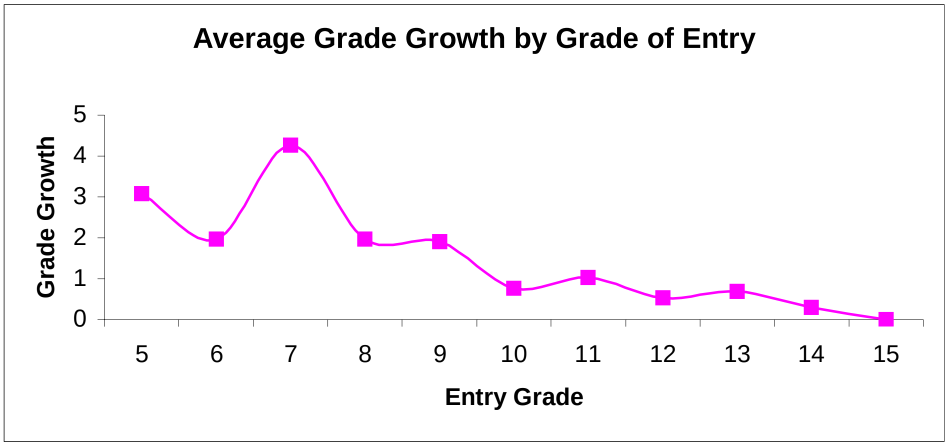
Bachelor_Degree	0.02458***	-0.0015
MA_MS95	0.00799	0.0092
PhD95	0.0059	0.06913*
Average_Rating		0.07384***
Grade	-0.01249***	

******* Significant at 0.01 level ****** Significant at 0.05 level * Significant at 0.1level
Source of Promotion_03 probit model: Column 3 of Table 21
Source of Supervisor_Promotion probit model: Column 3 of Table 22

At first glance, the models reveal different results for females, minorities and veterans when compared to males, whites and non-veterans. The results suggest that females receive lower annual and hourly compensation and are less likely to be promoted than men, even though they are better performers. The results also suggest that minorities are paid less and are less likely to be promoted. Veterans, on the other hand, are paid more, perform better, receive more promotions and are more likely to become supervisors. More educated employees are paid more and are promoted faster, but are not necessarily better performers. The models also confirmed that performance rating is a weak way to measure productivity.

Females produce different results than males, as is the case with minorities vs. whites and veterans opposed to non-veterans. The question is: are these differences created inside the civil service or are they due to differences in the characteristics of the population hired in 1995? Based on the information presented in Table 6, the average entry grade for females in 1995 is 5.98, while for males it is 8.18. Furthermore, the average promotion increase presented in Table 7 indicates that employees hired at lower grades have a higher progression when compared to their peers hired in higher grades. On average, an employee hired in 1995 in grade 5 had received 3.08 promotions by 2003, or an increase of 62% in grade level. Similarly, an employee hired in grade 7 in 1995 received 4.27 promotions by 2003, or an increase of 61% in grade level. The lower the employees' entry grades, the higher the percentage grade level increase they received by 2003. The grade increase per entry grade is shown in Graph 1.

Graph 1.   Grade Increase by Entry Grade



With regard to entry grade, males and females, and also minorities and veterans, follow different career paths, and are placed on different steps in the job ladder in the organizations hierarchical structure. Each one of these groups has a different promotion speed, due to the fact that job progression is partly determined by vacancy rates. As workers progress to upper grades, vacancies are reduced and job requirements change. Consequently, promotions, compensation, and average rating do not clearly depend on workers' performance or gender and race, as indicated by the models mentioned above. The extent to which promotions and average rating are dependent on employee performance will affect the final accuracy of the results.

THIS PAGE INTENTIONALLY LEFT BLANK

V. SUMMARY AND RECOMMENDATIONS

A. SUMMARY

This thesis explores the key factors that affect job performance and career progression of DOD civilian workers hired in 1995 who stayed in civil service until 2003. The thesis helps decision makers understand factors that are related to employee productivity, and what must be done to improve resource utilization.

Federal employees are subject to periodic evaluations based on objective, job-related criteria. The evaluations use performance standards for each job level, which the employees must fulfill to get a promotion. A five-level appraisal system is used, based on Performance Management Regulations. The DOD promotion system is based on merit and promotes employees according to a position's qualifications, the time-in-grade requirements, the time-after-competitive-appointment restriction, and the requirements for "fully successful" performance.

To determine the factors that affect performance and promotion, I used three proxy performance measures: compensation, promotion, and annual performance ratings. OLS and probit models were estimated to gauge the effect of gender, race, experience (a proxy for age), education and grade on employee productivity. In particular, as compensation (salary) models I used the log of annual compensation and the log of hourly compensation. As promotion measures I specified models of: number of promotions, at least one promotion, and promotion to supervisor. To describe performance I formed three models: High_Performance, Average_Rating, and ONETOP. The results, which are generally consistent with previous studies, were then corrected for selection on the retention margin.

The thesis provides insight into how people belonging to different races and gender perform, how they advance in the hierarchical ladder and how education and grade influence the final outcome. In general, females (although they perform better) and minorities are paid less and advance at lower rates compared to men and non-minority groups. In contrast, veterans receive higher salaries, receive more promotions and have a higher predicted probability of getting at least one promotion. Consistent with previous studies, the education coefficients indicate that an employee's rated performance does not seem to be correlated with human capital. However, more highly educated employees are paid more and promoted faster than their less-educated co-workers.

B. RECOMMENDATIONS

The multivariable models used in this thesis revealed that personnel productivity varies across the DOD workforce. Females in particular receive 1.6% higher annual ratings than men, have a 4.7% higher probability of receiving top rating and a 2.6% higher probability of being classified as a high performer. Personnel performance and productivity appear to strongly relate to the grade of entry. Women join DOD at a lower grade, on average, than men. The responsibilities are minor and the challenges are fewer in these grades. Possibly as a result, women get better ratings. This thesis also suggests that annual performance appraisals are a weak way to measure productivity. It would be useful to evaluate personnel productivity based on team productivity. In other words, it would be interesting to determine how teams perform and whether team performances match the individual's productivity. Do teams consisting of low-productive workers lose their targets? If not, then how can workers' ratings be explained?

The reason I used three different indicators of performance is that there is no standardized performance measure. Each employer and employee understands that concept differently, and the correct output indicator will differ across types of agencies. In DOD, performance is based on periodic evaluations of what workers accomplish. The results suggest that performance evaluations might not be accurate indexes of actual productivity. Although females perform better, they are promoted and paid less than men. The differences are not big, but tell us that the current DOD promotion and evaluation system must be improved or changed to match individual productivity differences. One way to improve the performance management system is to improve the data used. Additional information like self-assessment evaluations, peer assessments, and personal data (e.g., unexcused absenteeism) would be useful. A more accurate system will increase motivation and satisfaction among workers, help develop a strong commitment to DOD and, when the related data is used by researchers, will lead to more precise results. Additionally, a more accurate system that is based directly on criteria dependent on employees' actions will increase productivity and provide a sense of fairness.

Although females and minorities perform better, they receive fewer promotions than men (and whites) and were less likely to receive at least one promotion during the period 1995-2003. Promotions must be based on how well the workers perform at their current job. Promotions in DOD depend on the availability of job vacancies to which one can be promoted, skills of other employees, seniority, merit and, partly, on performance. To increase worker satisfaction and motivation, and to promote the right people to the right places, we must lessen the impact of position availability on promotion and must increase the role of performance and work experience. My personal opinion is that a two-speed promotion system could be implemented. Each promotion speed category will have different promotion rates. The more skilled employees will belong to the promotion speed with the higher promotion rate and will be able to advance to the highest levels of the hierarchical ladder. Others will experience a lower promotion speed and will be limited to promotions of a certain grade. The two-speed promotion system will result in increased motivation and productivity, since workers realize they must be capable to belong in the preferential category.

Performance model results suggest that signs of the education variables vary and most are insignificant, implying that more-educated people are not necessarily better performers. It is generally believed that education (training) improves job fit. As a result, I would expect that performance would be positively correlated with education. Not having a clear relationship between education and performance indicates that it is necessary for DOD to conduct an organization and education needs analysis that will provide information on whether additional education is required. Furthermore, the analysis would show what degrees and training are needed, determine the 'when' and the 'who' for these training and educational needs, and determine whether or not managers/supervisors support the implementation of the education plan. It is very important that the post-training period be examined for the trainees to assess if they effectively apply the knowledge, skills, and attitudes gained in training to their job. Also, one needs to examine to what extent the job environment provides opportunities for the trainees to apply what they learned. It is very possible that DOD overemphasizes the acquisition of skills and places too little weight on what happens in the work environment after training.

Based on the model results, there are performance, promotion and compensation differences between race/ethnic groups, and between veterans and non-veterans. DOD as an organization is structured in teams/working units where individuals interact to accomplish desired outcomes. To increase productivity and resource utilization, DOD must promote diversity inside its working teams [Triantis, 1975], diversity based on what team members know and how experienced they are and diversity based on more fundamental differences like gender and race. By eliminating differences in treatment among co-workers and by applying common cultural values, DOD will be able to reduce employee barriers regarding stereotypes, values and work practices that constrain their contribution and delay their development. However, diversity has a price. Interpersonal communication becomes more difficult. As a result, in order to form diverse groups DOD must train its personnel to view the actions and thoughts of the member of the other groups as functional and reasonable to produce a sense of cohesion.

As a final recommendation, I want to mention the change of the pay system in DOD. Until recently, salary has been based on the grade the employee attains, adjusted for locality. The pay system must make a clear distinction in the future by paying jobs, not individuals. The job itself must determine the level of compensation, not the people in them. The new pay system must reward effort, skills, responsibility and working conditions. By doing so, DOD will encourage employees to give their best.

APPENDIX HECKMAN RETENTION MODELS

Variables	Table13 Column 3	Table14 Column 3	Table15 Column 3	Table16 Column 3	Table17 Column 3	Table19 Column 3	Table20 Column 3	Table21 Column 3
	stay	stay	stay	stay	stay	stay	Stay	stay
Female	-0.0571	-0.0597	-0.0785	-0.0904	-0.0600	-0.0186	-0.1248	-0.1353
	(0.0284) **	(0.0284) **	(0.0280) ***	(0.0284) ***	(0.0280) **	(0.027)	(0.0300) ***	(0.0331) ***
Black	0.0223	0.0236	0.0048	0.0052	-0.0080	0.0012	-0.0131	0.0296
	(0.0330)	(0.0331)	(0.0329)	(0.0329)	(0.0327)	(0.032)	(0.0363)	(0.0381)
Hispanic	0.2272	0.2279	0.2137	0.2203	0.2008	0.2123	0.1899	0.2332
	(0.0542) ***	(0.0542) ***	(0.0540) ***	(0.0539) ***	(0.0536) ***	(0.053)***	(0.0589) ***	(0.0631) ***
Other_ Race	0.1741	0.1726	0.1636	0.1750	0.1710	0.1637	0.1182	0.1343
	(0.0446) ***	(0.0447) ***	(0.0446) ***	(0.0447) ***	(0.0442) ***	(0.044)***	(0.0481) **	(0.0510) ***
Veteran	0.2202	0.2220	0.2221	0.2182	0.3476	0.3617	0.1346	0.1324
	(0.0401) ***	(0.0401) ***	(0.0400) ***	(0.0400) ***	(0.0371) ***	(0.0370) ***	(0.0441) ***	(0.0462) ***
Veter_Fed _Experien ce	-0.0199	-0.0204	-0.0204	-0.0199	-0.0269	-0.0270	-0.0194	-0.0178
	(0.0045) ***	(0.0045) ***	(0.0045) ***	(0.0045) ***	(0.0044) ***	(0.0044) ***	(0.0050) ***	(0.0052) ***
Total_Fed eral_Serv ice_Years _95	0.0523	0.0530	0.0570	0.0566	0.0441	0.0427	0.0474	0.0424
	(0.0056) ***	(0.0056) ***	(0.0055) ***	(0.0055) ***	(0.0054) ***	(0.0054) ***	(0.0062) ***	(0.0065) ***
Total_Fed eral_Serv ice_Years _95sq	-0.0018	-0.0018	-0.0018	-0.0018	-0.0016	-0.0016	-0.0014	-0.0013
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0003)

	***	***	***	***	***	***	***	***
Labor_Market_Experience_sq	-0.0013	-0.0013	-0.0013	0.0534	-0.2557	-	0.0496	0.0479
	(0.0001) ***	(0.0001) ***	(0.0001) ***	(0.0036) ***	(0.0424) ***	-	(0.0041) ***	(0.0043) ***
Labor_Market_Experience	0.0499	0.0498	0.0541	-0.0013	-0.1048	-0.2380	-0.0012	-0.0012
	(0.0037) ***	(0.0037) ***	(0.0036) ***	(0.0001) ***	(0.0351) ***	(0.0397) ***	(0.0001) ***	(0.0001) ***
Other_ Agent	-0.2537	-0.2530	-0.2563	-0.2555	-0.1369	-0.1190	-0.3008	-0.1058
	(0.0427) ***	(0.0428) ***	(0.0427) ***	(0.0423) ***	(0.0816) *	(0.0345) ***	(0.0438) ***	(0.0510) **
Navy	-0.0790	-0.0740	-0.0844	-0.0801	0.0290	-0.1606	-0.1766	-0.0891
	(0.0354) **	(0.0354) **	(0.0353) **	(0.0353) **	(0.0327)	(0.0813) **	(0.0390) ***	(0.0403) **
USMC	-0.1368	-0.1413	-0.1412	-0.1359	0.0143	0.0306	-0.2094	-0.0573
	(0.0823) *	(0.0825) *	(0.0822) *	(0.0822) *	(0.0328)	(0.0323)	(0.0917) **	(0.0942)
USAF	-0.0508	-0.0474	0.0147	0.0164	0.0947	-0.2380	-0.1200	-0.0025
	(0.0341)	(0.0341)	(0.0327)	(0.0326)	(0.0489) *	(0.0397) ***	(0.0368) ***	(0.0382)
Avg_Performance96_98	-	-	-	-	-	-	-	0.1991
	-	-	-	-	-	-	-	(0.0206) ***
Bachelor_ Degree	0.0952	0.0899	0.0752	0.0700	-0.0763	-0.0425	0.0386	0.0341
	(0.0340) ***	(0.0341) ***	(0.0335) **	(0.0333) **	(0.0963)	(0.0324)	(0.0349)	(0.0386)
MA_MS95	0.1327	0.1343	0.1293	0.1179	-	0.0426	0.0818	0.0615
	(0.0504) ***	(0.0504) ***	(0.0493) ***	(0.0491) **	-	(0.0481)	(0.0518)	(0.0568)
PhD95	-0.1069	-0.1085	-0.0669	-0.0889	-0.4398	-0.0954	-0.1472	-0.2589

	(0.0987)	(0.0990)	(0.0971)	(0.0970)	(0.0486) ***	(0.0953)	(0.1023)	(0.1103) **
Average_ Rating	-	-	-	-	-	-	-0.0749	-
	-	-	-	-	-	-	(0.0209) ***	-
Education _Change	0.0747	0.0741	-	-	-	-	-	-
	(0.0137) ***	(0.0137) ***	-	-	-	-	-	-
Grade	0.0294	0.0292	0.2584	-	-	-	-	0.0275
	(0.0064) ***	(0.0064) ***	(0.0600) ***	-	-	-	-	(0.0075) ***
Occupation Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.9293	-0.9290	-0.9296	-0.7564	-0.4398	-0.4957	0.1781	-1.4244
	(0.0624) ***	(0.0624) ***	(0.0624) ***	(0.0525) ***	(0.0486) ***	(0.0450) ***	(0.1076) *	(0.1138) ***
Observati ons	13512	13485	13502	13502	13502	13331	10261	10023

******* Significant at 0.01 level ****** Significant at 0.05 level * Significant at 0.1le
Standard errors in parenthesis

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF REFERENCES

Asch, Beth J, *The Pay, Promotion, and Retention of High-Quality Civil Service Workers in the Department of Defense*, RAND, 2001.

Bishop, John, "The Recognition and Reward of Employee Performance," *Journal of Labor Economics*, *Part 2: The New Economics for Personnel*, vol. 5, no. 4, Oct 1987, S36-S56.

Defense Logistic Information Service. http://www.dlis.dla.mil/employment/benefits_fed.asp. Accessed 17 November 2004.

DiPrete, Thomas A. and Whiman, Soule T, "Gender and Promotion in Segmented Job Ladder Systems," *The American Sociological Review*, vol. 53, no. 1, Feb 1988, pp. 26-40.

Dunson, Bruce, "Pay, Experience, and Productivity: The Government-Sector Case," *Journal of Human Resources*, vol. 20, no. 1, Winter 1985, pp. 153-160.

"The Federal Merit Promotion Program. Process vs. Outcome." http://www.mspb.gov/studies/rpt_02-20-02_promotion. Accessed 20 November 2004.

Heckman, James J, "Sample Selection as a Specification Error," *Econometrica*, vol. 47, no. 1, Jan 1979, pp. 153-162.

Lewis, Gregory B., "Gender and Promotions: Promotion Chances of White Men and Women in Federal White-Collar Employment," *Journal of Human Resources*, vol. 21, no. 3, Summer 1986, pp. 406-419.

Mehay, Stephen and Pema, Elda, "Gender Differences and Job Performance and Career Progression: Evidence from Personnel Data," Naval Postgraduate School, Monterey, California, 2004.

Naff, Katherine C., "Through the Glass Ceiling: Prospects for the Advancement of Women in the Federal Civil Service," *Public Administration Review*, vol. 54, no. 6, Nov-Dec 1994, pp. 507-514.

Office of Personal Management. http://www.opm.cc.nih.gov/employ/paylance.html, Accessed 17 November 2004.

Triantis, H.C., "Culture Training, Cognitive Complexity and Interpersonal Attitudes," *Cross-Cultural Perspective on Learning*, 1975, pp. 39-77.

Usan, Abdullah and Utoglu, Mustafa, *The Effect of Graduate Education on the Job Performance of Civilian Department of Defense Employees*, Master's Thesis, Naval Postgraduate School, Monterey, California, Sep 1999.

Wise, David A., "Academic Achievement and Job Performance," *The American Economy Review*, vol. 65, no. 2, Jun 1975, pp 335-348.

Wise, David A., "Personal Attributes, Job Performance, and Probability of Promotion," *Econometrica*, vol. 43, no. 5-6, Sep-Nov, 1975, pp. 913-932.

Wooldridge, Jeffrey M., *Introductory Econometrics*, 2nd ed., Thomson South Western, 2003, pp. 310-591.

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
   Ft. Belvoir, Virginia.

2. Dudley Knox Library
   Naval Postgraduate School
   Monterey, California.

3. Professor Stephen Mehay
   Naval Postgraduate School
   Academic Associate, Manpower System Analysis
   Monterey, California.

4. Professor Elda Pema
   Naval Postgraduate School
   Monterey, California.

5. Kathryn M. Kocher (Code SM/Ko)
   Naval Postgraduate School
   Monterey, California.

6. Lieutenant Commander Dimitrios Spyropoulos H.N.
   Papagos, Athens
   Greece.